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Amanita alpinicola sp. nov.

(Cripps, Lindgren & Barge— FIG. 3, p. 671)

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2017 Mycotaxon submission procedure

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From the Editor-in-Chief

Type descriptions and range extensions—In Mycotaxon 132-1 (ix–x), we announced our new requirements for papers devoted to range extensions of previously named taxa. These included the presentation of an original technical description based on the newly collected specimens, an illustration, a list of the specimens examined, and a discussion comparing the new record with previously published descriptions/data for the taxon.

One item we did not cover is the importance of referring to original (type) descriptions and well-researched monographs to confirm an identification prior to publishing a new record. Referring to the more general literature (such as pictorial field guides) are very helpful during the initial identification process, but it is unwise to rely on literature published for a country well removed from the new collection: a species reported from England may well present different features from the type originally described from Japan. The **original** type description or a complete description based on material from the type locality should always be compared with an extralimital collection before publishing a range extension.

Mycotaxon 132(3) contains 27 papers by 114 authors (representing 16 countries) and revised by 38 expert reviewers.

Within its pages are six new genera (*Alcornia, Blastoheterospora, Craspedodidymella, Distoceratosporella, Gonatophragmiopsis, Zelotetraploa,* all from Brazil) and 26 species new to science representing *Amanita* from the U.S.A.; *Blastoheterospora, Craspedodidymella, Distoceratosporella, Gonatophragmiopsis, Pithomyces, Zelotetraploa* from Brazil; *Catenularia, Cephalotrichum, Cladosporium, Coniochaeta, Diaporthe, Drechslera, Fusariella, Lecanora, Leptographium, Myrothecium, Neosporidesmium, Phialophora, Pseudoramichloridium, Pyricularia, Ticogloea, Tripospermum, Wiesneriomyces* from China; *Lactifluus* from Cameroon; and *Zygosporium* from Venezuela.

In addition to range extensions for previously named taxa covering macrofungi (Pakistan, Thailand, Turkey), hyphomycetes (China), lichens & lichenicolous fungi (China, Turkey), and myxomycetes (Ukraine), we also offer new combinations in *Alcornia, Distoceratosporella,* and *Vamsapriya* together with excellent documentations of *Colletotrichum fioriniae* infecting hazelnut in Turkey and bioluminescence (*Mycena, Panellus*) in Mexico.

Warm regards,

Lorelei L. Norvell (*Editor-in-Chief*)
27 September 2017

In remembrance

Courtesy of Luís F.P. Gusmão

Marcos Fábio de Oliveira Marques (1980–2017): Marcos Fábio was born on March 28, 1980, in the municipality of Feira de Santana, Bahia, Brazil. After graduating in the biological sciences from State University of Feira de Santana (UEFS), he obtained his masters in Fungal Biology (2001) from Federal University of Pernambuco (UFPE) and his doctorate in Botany (2006) from UEFS, where he focused on the taxonomy, ecology, and popularization of mycology and eventually earned the affectionate nickname of "Funguinho" from his students and colleagues. At the time of his sudden death at the age of 37, Dr. Marques was Full Professor of the undergraduate Biological Sciences program and the Vegetal Biodiversity graduate program and served as Director of the Department of Education of the State University of Bahia (DEDC/UNEB – Campus VII).

He concentrated his study on conidial fungi, especially from the semi-arid region of Northeast of Brazil, where he collected many rare or uncommon asexual fungi. Marcos had a finely honed sense for new fungal taxa in the Brazilian Semi-arid region, which he shared with his students. Listed (as "M.F.O. Marques") in MycoBank and Index Fungorum as author or coauthor of two new genera and seven new species, Prof. Marques contributed to 23 articles on the taxonomy, diversity and ecology of conidial fungi [https://www.researchgate.net/profile/Marcos_Marques3]. He published in Mycotaxon (eight papers) and other journals including Acta Botanica Brasilica, Brazilian Journal of Botany, Journal of Forestry Research, and Mycologia.

ResearchGate photo

Dr. Luís F. P. Gusmão (UEFS), who shared the above 2015 photograph of his colleague at the Espaço–Ciência Micológica/UNEB, writes: "Dr. Marcos Fabio Oliveira Marques was one of my first students in the undergraduate course in

biological sciences at UEFS. From the beginning he showed great promise in mycology. He loved the taxonomy of conidial fungi and soon became a specialist and master of this group. However, as taxonomy alone was not enough, he combined ecology with taxonomy for his PhD. I was supervisor of Marcos in all the phases of his mycological development and I am sure that we lost a promising and excellent mycologist. My last meeting with Marcos was in June / 2017 during an evaluation of two doctoral theses of my students in. Marcos died as a result of a car crash on August 3, 2017."

Danilo Oliveira

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Lactifluus persicinus sp. nov. from the gallery forests of West Cameroon

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Abstract—During field work in the Noun division of western Cameroon during 2011, 2012, and 2014, several collections of an unknown *Lactifluus* species were discovered in a gallery forest with *Uapaca guineensis*. Molecular and morphological research shows that these collections represent a new species, *Lactifluus persicinus*, which is described in this paper. *Lactifluus persicinus* belongs to *Lf.* sect. *Xerampelini* in *Lf.* subg. *Pseudogymnocarpi.*

Key words—*Russulaceae*, ectomycorrhizal fungi, tropical Africa, edible mushroom, pseudocryptic species

Introduction

The *Russulaceae* are a family containing important ectomycorrhizal genera. In 2008, molecular research challenged existing generic concepts, resulting in the splitting of *Russula* Pers. and *Lactarius* Pers. into four segregate genera—*Lactarius*, *Russula*, *Multifurca* Buyck & V. Hofst., and *Lactifluus* (Pers.) Roussel (Buyck et al. 2008). The species-rich milkcap genus *Lactifluus* (*Lf.*) comprises about 150 described species worldwide. Furthermore, at least 17 (possibly up to 44) species still await description (De Crop et al. 2017). *Lactifluus* has a mainly tropical distribution, with the highest known diversity in tropical Africa (Bâ et al. 2012, De Crop et al. 2012, Maba 2015, Maba et al. 2015a, Van de Putte et al. 2009, Verbeken & Walleyn 2010) and tropical Asia (Le 2007, Stubbe et al.

TABLE 1. *Lactifluus* (*Lf.*) specimens and GenBank sequences used in the molecular analyses. Type specimens are annotated as [T].

SPECIES	VOUCHER (HERBARIUM)	COUNTRY	ITS	LSU
Lactifluus* sect. *Pseudogymnocarpi				
Lf. cf. *pseudogymnocarpus*	AV 05-085 (GENT)	Malawi	KR364012	KR364139
Lf. cf. *pumilus*	EDC 12-066 (GENT)	Cameroon	KR364067	KR364196
Lf. gymnocarpoides	JD 885 (BR)	Congo	KR364074	KR364203
	AV 05-184 (GENT)	Malawi	KR364024	KR364151
Lf. hygrophoroides	AV 05-251 (GENT)	North America	HQ318285	HQ318208
Lf. longisporus	AV 94-557 (GENT) [T]	Burundi	KR364118	KR364244
Lf. luteopus	AV 94-463 (GENT) [T]	Burundi	KR364119	—
Lf. medusae	EDC 12-152 (GENT)	Cameroon	KR364069	KR364198
Lf. pseudoluteopus	FH 12-026 (GENT)	Thailand	KR364084	KR364214
Lf. sudanicus	AV 11-174 (GENT) [T]	Togo	HG426469	KR364186
Lactifluus* sect. *Xerampelini				
Lf. persicinus	EDC 14-371 (GENT)	Cameroon	KX499389	—
	EDC 12-002 (GENT)	Cameroon	KX499392	KX622761
	EDC 12-004 (GENT)	Cameroon	KX499390	KX622760
	EDC 12-001 (GENT) [T]	Cameroon	KR364061	KR364190
	NAL 348 (GENT)	Cameroon	KX499391	—
Uncultured ectomycorrhiza	—	Guinea	AM113441	—
Lf. goossensiae	AB 320 (GENT)	Guinea	KR364132	KR364252
Lf. cf. *pseudovolemus*	ADK 2927 (BR)	Benin	KR364113	KR364243
	ADK 2968 (BR)	Benin	KX499393	—
Lf. kivuensis	JR Z366 (GENT)	Congo	KX499399	—
	JR Z439 (GENT)	Congo	KX499398	—
	JR Z 310 (GENT) [T]	Congo	KR364027	KR364154
Lf. rubiginosus	JD 959 (BR)	Congo	KR364081	KR364210
	BB 3466 (GENT) [T]	Zambia	KR364014	KR364250
Lf. xerampelinu	TS 1116 (GENT) [T]	Tanzania	KR364039	KR364166
	MH 201176 (GENT)	Mozambique	KR364099	KR364231
	CS 2889 (GENT)	Zimbabwe	KX499394	—
Lf. sp.	EDC 12-176 (GENT)	Cameroon	KR364070	KR364199
	EDC 12-071 (GENT)	Cameroon	KX499396	KX622762
	EDC 14-284	Cameroon	KX499395	—
Uncultured ectomycorrhiza	—	Gabon	FR731875	—
Lf. sp.	AV 11-022 (GENT)	Tanzania	KX499397	KX622763
Unnamed clade				
Lf. sp.	JN 2011-012 (GENT)	Vietnam	KR364045	KR364171
	TENN 065929 (TENN)	North America	KR364102	KR364233
	EDC 14-501 (GENT, MFLU)	Thailand	KR364127	—
Lf. volemoides	TS 0705 (GENT) [T]	Tanzania	KR364038	KR364165
Lactifluus* sect. *Aurantiifolii				
Lf. aurantiifolius	AV 94-063 (GENT) [T]	Burundi	KR364017	KR364144

Lactifluus* sect. *Rubroviolascentini				
Lf. aff. *rubroviolascens*	EDC 12-051 (GENT)	Cameroon	KR364066	KR364195
Lf. carmineus	AV 99-099 (GENT) [T]	Zimbabwe	KR364131	KR364251
Lf. denigricans	EDC 11-218 (GENT)	Tanzania	KR364051	KR364178
Lf. kigomaensis	AV 11-006 (GENT)	Tanzania	KR364052	KR364179
Lf. sp.	EDC 11-159 (GENT)	Tanzania	KR364050	KR364177
Lactifluus* sect. *Polysphaerophori				
Lf. pegleri	PAM/Mart 12-091 (LIP)	Martinique	KP691416	KP691425
Lf. sp.	RC/Guy 09-036 (LIP)	French Guiana	KJ786645	KJ786550
	MR/Guy 13-145	French Guiana	KJ786691	KJ786595
	MCA 3937 (GENT)	Guyana	KR364109	KR364240
Lf. veraecrucis	M 8025 (ENCB) [T]	Mexico	KR364112	KR364241
Outgroup (*Lf.* subg. *Lactifluus*)				
Lf. corrugis s.l.	AV 05-392 (GENT)	North America	JQ753822	KR364143
Lf. crocatus	KVP 08-034 (GENT)	Thailand	HQ318243	HQ318151
Lf. vitellinus	KVP 08-024 (GENT)	Thailand	HQ318236	HQ318144
Lf. volemus	KVP 11-002 (GENT)	Belgium	JQ753948	KR364175
Lf. acicularis	KVP 08-002 (GENT)	Thailand	HQ318226	HQ318132

2010, Van de Putte 2012, Van de Putte et al. 2010). Species diversity is high in the Guineo-Sudanian domain (Maba 2015; Maba et al. 2014, 2015a, 2015b), with around 38 *Lactifluus* species currently known from the area. However, certain regions within this area remain poorly explored with potentially many new species yet to be discovered and described. In one such region, Cameroon, most studies have been located in the tropical rainforest (Douanla-Meli & Langer 2009, Verbeken et al. 2008), and little is known about milkcaps in the savannas, from which only one *Lactifluus* species, *Lf. albomembranaceus* S. De Wilde & Van de Putte, has been described (De Crop et al. 2016).

Southern Cameroon is dominated by closed evergreen lowland forest, while the centre of the country is dominated by deciduous woodland and shrubland (WRI 2003). The tropical forest does not undergo a gradual change to savanna or woodland; instead the zone between these two habitats consists of habitat patches with abrupt borders. This transition zone is called the 'forest-savanna mosaic' since it contains forest islands and savannas, as well as woodlands (White 1983). In contrast to savannas and woodlands, dense tree cover characterizes the forest islands, with the resulting competition for light leading to an understory with much lower abundances of grasses than in the savannas or woodlands (Azihou et al. 2013, Hoffmann et al. 2009, Natta et al. 2003). Forest islands that occur alongside waterways are known as gallery forests. The plant groups *Caesalpinioideae* (represented by *Berlinia* Sol. ex Hook. f.)

and *Phyllanthaceae* (represented by *Uapaca* Baill.) dominate the Central and West African gallery forests. These trees are ectomycorrhizal hosts, making the humid gallery forests an ideal habitat in which to find ectomycorrhizal fungi.

A recent survey of wild mushrooms in the West region of Cameroon revealed nine edible *Lactifluus* species, all collected in gallery forests (Njouonkou et al. 2016). From the same division, *Lf. albomembranaceus* was described (De Crop et al. 2016). It is from this habitat that the new species described here, *Lactifluus persicinus*, was discovered.

Materials & methods

Sampling

During fieldwork in 2011, 2012, and 2014 in gallery forests within the Noun division of western Cameroon, 15 collections of *Lactifluus persicinus* were made.

Morphological analysis

Macroscopic characters were observed from fresh material, with colour codes referring to Kornerup & Wanscher (1978). Microscopic characters were observed from dried material. Spores were mounted in Melzer's reagent and measured in side view without ornamentation. A total of 186 spores were measured among 14 collections. The measurements are given as [Ava-2xSDa]–*Ava*–*Avb*–[Avb+2xSDb] in which *Ava* = lowest mean value for the measured collections, *Avb* = greatest mean value and SDa/b = standard deviation of the lowest and greatest mean value respectively. As an indication for spore shape, Q was also determined, where Q is the quotient of length and width and is given as MINQ–*AvQa*–*AvQb*–MAXQ, with *AvQa* and *AvQb* the lowest and the highest mean quotient, respectively, for the measured specimens. MINQ/MAXQ stands for the minimum/maximum value over the quotients of all available measured spores. The hymenium, pileipellis and stipitipellis were mounted in Congo red. The measurements of the basidia do not include the sterigmata. Line drawings were made with the aid of a drawing tube at following magnifications: 6000× for spores (Zeiss Axio Scope 2 microscope), 1500× for other hymenial elements and sections (Olympus cx31 microscope). For the SEM pictures, the spores were coated in a Quorum Q150TS sputter coater with 5 nm thick Pt/Pd (platinum palladium) and studied using a Jeol JSM-7600F Field Emission Scanning Microscope.

Molecular analysis

DNA from dry collections was extracted using the protocol described by Nuytinck & Verbeken (2003) with modifications described in Van de Putte et al. (2010). DNA was extracted from fresh material using the CTAB extraction described in Nuytinck & Verbeken (2003). Protocols for PCR amplification follow Le et al. (2007). Two nuclear markers previously shown as informative within this subgenus (De Crop et al. 2017) were used: (1) the internal transcribed spacer region of ribosomal DNA (ITS), comprising the ITS1 and ITS2 spacer regions and the ribosomal gene 5.8S, using primers ITS-1F and

ITS4 (Gardes & Bruns 1993, White et al. 1990) and (2) a part of the ribosomal large subunit 28S region (LSU), using primers LR0R and LR5 (Moncalvo et al. 2000).

PCR products were sequenced using an automated ABI 3730 XL capillary sequencer (Life Technology) at Macrogen. Forward and reverse sequences were assembled into contigs and edited where needed with the Sequencher v5.0 software (Gene Codes Corporation, Ann Arbor, MI, U.S.A.).

From De Crop et al. (2017) we knew that *Lactifluus persicinus* represented *Lactifluus* subg. *Pseudogymnocarpi* (Verbeken) De Crop and *Lf.* sect. *Xerampelini* De Crop. The dataset for phylogenetic analyses contained sequences from *Lactifluus* subg. *Pseudogymnocarpi* (De Crop et al. 2017) and we added more newly generated sequences plus two GenBank sequences within *Lf.* sect. *Xerampelini*. For other sections only one sequence per species was included. Five species representing *Lf.* subg. *Lactifluus* were used as outgroup (Table 1).

Sequences were aligned online using the E-INS-I strategy version of the multiple sequence alignment program MAFFT v7 (Katoh & Toh 2008). Trailing ends were trimmed and the alignment was manually edited when necessary in Mega 6 (Tamura et al. 2013). The alignment can be obtained from the first author and TreeBASE (Submission ID 19693). The alignment was partitioned into partial 18S, ITS1, 5.8S, ITS2 and partial 28S. Maximum likelihood (ML) analyses were conducted with RAxML v8.0.24 (Stamatakis 2014), where a ML analysis was combined with the Rapid Bootstrapping algorithm with 1000 replicates under the GTRCAT option (Stamatakis et al. 2008). All analyses were performed on the CIPRES Science Gateway (Miller et al. 2010).

Results

The molecular results placed the new species in *Lf.* subg. *Pseudogymnocarpi* and *Lf.* sect. *Xerampelini*. Its sister clade contains collections previously identified as *Lf. goossensiae* (Beeli) Verbeken from Guinea and *Lf.* cf. *pseudovolemus* (R. Heim) Verbeken from Benin. The new species, described below as *Lf. persicinus*, is morphologically very similar to the collections within this sister clade with which it is compared.

Lactifluus persicinus Delgat & De Crop, **sp. nov.** Figs 1–3

MycoBank MB 817873

Differs morphologically from its sister clade (collections AB 320, ADK 2927 and ADK 2968) by its shorter basidia.

type: Cameroon, Western region, Noun division, Koutaba subdivision, Mamevouo village, gallery forest in savannah region, *Uapaca guineensis*, 5°41′01″N 10°49′28″E, 1126 m, 8 May 2012, EDC 12-001 (**Holotype**, GENT)

Etymology: Referring to the peach-like color and surface of the basidiocarp.

Pileus 37–73 mm diam., firm, plano-concave with depressed centre to deeply infundibuliform; margin straight to inflexed, broadly grooved (c. 2–3 mm)

Fig. 1. *Lactifluus persicinus* basidiocarps: a. holotype, EDC 12-001; b. EDC 14-349; c. EDC 12-002; d. EDC 14-349; e. EDC 14-380; f. EDC 14-380. (Photos by E. De Crop).

reaching halfway across the pileus; surface chamois-leather-like, slightly velutinous when young, cream yellow to orange to pink (5A3–6A2), some pilei slightly darker (6B4–7C4), locally more pink or more yellow, concentrically wrinkled near margin. Stipe 32–48 × 8–14 mm, cylindrical, sometimes tapering downwards or curving at the base; surface slightly irregular, almost smooth, very soft (softer than pileus), slightly velutinous or chamois-leather-like, almost concolourous with pileus but slightly paler, cream yellow-orange (5A3, 5A4 to 6A3), sometimes with a pinkish tinge, pale at top, becoming darker orange towards the base (5A5–5B5). Lamellae decurrent with rather long teeth, very broad, thick, strongly transvenose and slightly intervenose, sometimes bifurcating towards the margin, brittle, distant (2+3–5 L+ll/cm), paler than pileus, cream yellow with pinkish tinge (4A3–5A2); edge concolourous and entire. Context white, firm, unchanging, unchanging with guaiac, slightly pink with $FeSO_4$. Smell not remarkable. Taste mild. Latex abundant, watery white, unchanging, taste mild.

Basidiospores broadly ellipsoid to ellipsoid, rarely slightly elongate, 6.9–*9.2–10.9*–12.8 × 5.7–*6.7–7.7*–9.4 µm (Q = 1.10–*1.33–1.48*–1.70); ornamentation amyloid, composed of low (1 µm at most) elongated warts, aligned or connected

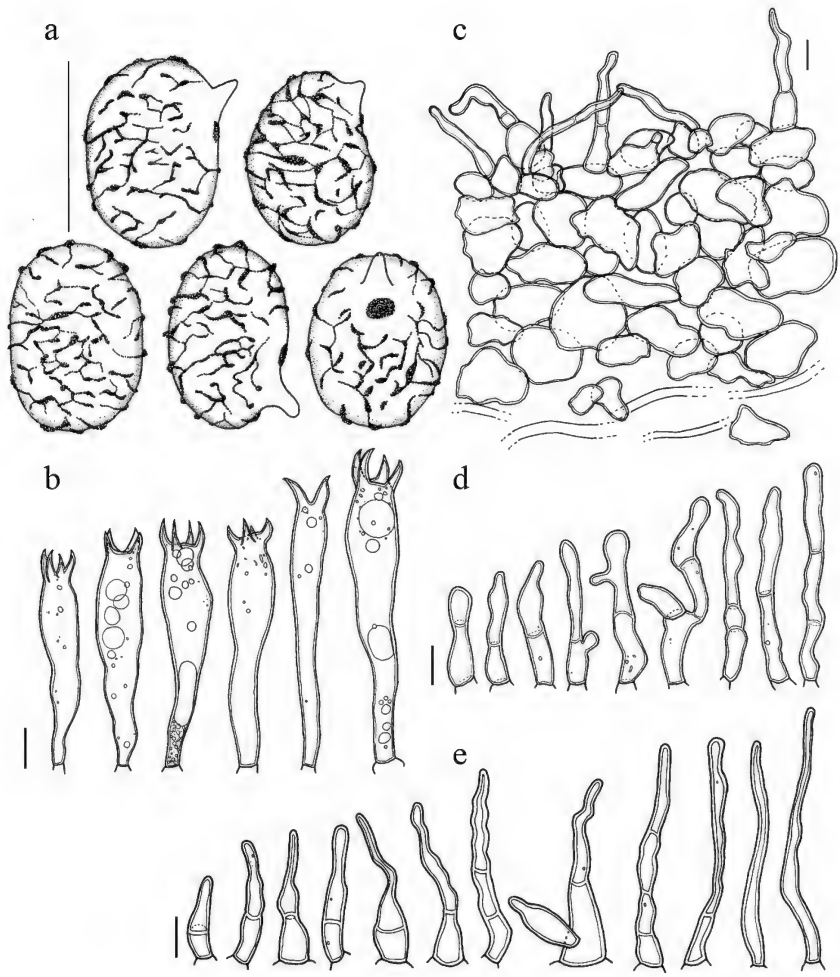

FIG. 2. *Lactifluus persicinus:* a. basidiospores; b. basidia; c. section through the pileipellis; d. sterile elements from the hymenium; e. pileipellis hairs. Scale bar = 10 μm. (Line drawings by L. Delgat).

by fine connective lines, forming an incomplete reticulum, with only few isolated warts; plage sometimes distinct and with a central amyloid spot. BASIDIA 45–74(–90) × (8–)8.5–11.5(–12.5), cylindrical to subclavate, 4-spored, rarely 2-spored, slightly thick-walled. STERILE ELEMENTS abundant, 21–60 × 3.5–7 μm, some emergent, majority not emergent, cylindrical, septate, with rounded apex, wall slightly thickened. PLEUROCYSTIDIA absent. PLEUROPSEUDOCYSTIDIA

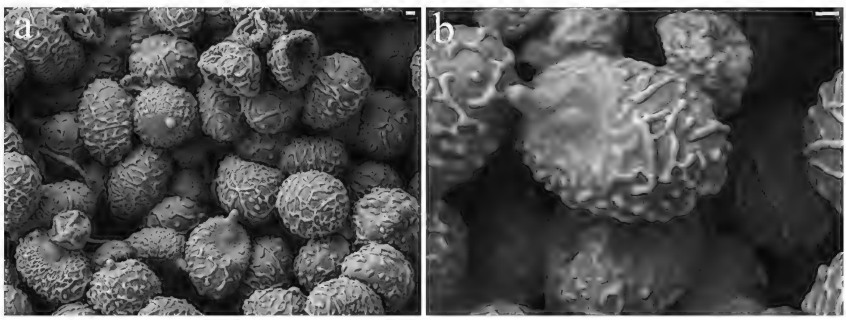

FIG. 3. *Lactifluus persicinus* (holotype, EDC 12-001) basidiospores (SEM): a. overview; b. detail of basidiospores. Scale bars = 1 µm.

scarce, 6–10 µm diam., cylindrical with rounded apex, often remarkably emergent, sometimes not emergent. LAMELLAR EDGE fertile. HYMENOPHORAL TRAMA cellular, with lactifers and sphaerocytes. PILEIPELLIS a lampropalisade; elements of the suprapellis 19–65 × 3–11 µm, cylindrical to cylindrical with broadened base, often septate, thick-walled; subpellis composed of slightly thick-walled globose/isodiametric cells (10–30 µm diam.), up to 80 µm thick. STIPITIPELLIS a lamprotrichoderm to lamprotrichopalisade, with many parallel hyphae, part of them ascending; terminal elements more abundant than in the pileipellis, occurring in tufts, cylindrical, cylindrical with a bulbous base or broadly ellipsoid to globose, often septate, slightly thick-walled.

USE – *Lactifluus persicinus* is used as food by Bamoun people in the Noun division of the west region of Cameroon.

LOCAL NAME – *Lactifluus persicinus* is locally called "Puo' mbum mon (pwɔ̀' mbʉm moŋ)" by Bamoun people. "Puo'" is a general word for mushroom. "Mbum mon" is the local name of a herbaceous *Euphorbia* species, namely *Euphorbia heterophylla* L., which is an annual plant with white milky latex in all parts of the plant. This name is related to the fact that *Lactifluus persicinus* produces abundant white latex like *Euphorbia* species. However, this name also seems to be used for other milkcap species.

ECOLOGY – found in Cameroon in the 'forest-savanna mosaic' zone in gallery forests with *Uapaca guineensis* Müll. Arg.

DISTRIBUTION – known only from Cameroon.

ADDITIONAL SPECIMENS EXAMINED – **CAMEROON, WESTERN REGION, Noun division**, Koutaba subdivision, Mamevouo village, gallery forest in savannah region, *Uapaca guineensis*, 5°41′01″N 10°49′28″E, 1126 m, 8 May 2012, EDC 12-002, EDC 12-003, EDC 12-004 (GENT); 5°39′12″N 10°50′54″E, 1062 m, 10 May 2012, EDC 12-050 (GENT); 5°40′59″N 10°49′29″E, 1122 m, 27 May 2014, EDC 14-349 (GENT); 5°40′48″N

10°49′28″E, 1139 m, EDC 14-361 (GENT); 5°39′27″N 10°50′57″E, 1063 m, 29 May 2014, EDC 14-371 (GENT); 5°39′26″N 10°50′57″E, 1113 m, EDC 14-374 (GENT); 5°39′10″N 10°51′00″E, 1117 m, EDC 14-376 (GENT); 5°39′10″N 10°51′01″E, 1093 m, EDC 14-378 (GENT); 5°38′60″N 10°51′05″E, 1117 m, EDC 14-380 (GENT); 5°38′58″N 10°51′03″E, 1120 m, EDC 14-385, EDC 14-386 (GENT); 5°39′37″N 10°50′48″E, 1099 m, 22 August 2011, NAL 348 (GENT).

Discussion

Lactifluus persicinus is recognizable in the field as a typical *Lactifluus* because of the chamois-leather-like surface of the cap. This is confirmed under the microscope by the cellular hymenophoral trama and the lampropalisade pileipellis structure. Molecular data also confirm placement within *Lactifluus* (Fig. 4).

Within the genus, *Lactifluus persicinus* belongs to *Lf.* subg. *Pseudogymnocarpi*, which is supported by molecular data (De Crop et al. 2017), as well as by morphological characters, such as the lampropalisade pileipellis structure, yellow/orange cap colour, and absence of colour reactions of the latex as in most species of this subgenus.

Lactifluus persicinus is placed within the section *Lf.* sect. *Xerampelini*, a section containing exclusively African species (Fig. 4). It also fits morphologically within this clade, which is characterized by yellowish-orange to reddish-brown cap colours, palisade-like pileipellis structure, absence of clear cystidia, and generally low ornamented spores (usually not higher than 0.2 µm) that are verrucose or form a more or less complete reticulum.

The sister clade of *Lf. persicinus* contains collections previously identified as *Lf. goossensiae* and *Lf.* cf. *pseudovolemus* (Fig. 4) from Guinea and Benin. However, *Lf. pseudovolemus* is known only from Madagascar, and several macro- and microscopic characters mentioned in the description (Heim 1938) are not concordant with characters of the collections in this clade. In addition, we have studied the type material of *Lf. goossensiae* and this species also seems to differ both macro- and microscopically from the sequenced collections in this clade (e.g. the type of *Lf. goossensiae* has smaller spores). It seems likely that this sister clade represents neither *Lf. pseudovolemus* nor *Lf. goossensiae*. As it was not possible to obtain sequences from the types of *Lf. pseudovolemus* and *Lf. goossensiae* to test the two species molecularly, the identities of the specimens assigned to the sister clade remain unconfirmed.

Although *Lactifluus persicinus* is clearly delimited from its sister clade molecularly, morphologically the two clades are difficult to distinguish from each other and might be considered (pseudo) cryptic species. Macroscopically

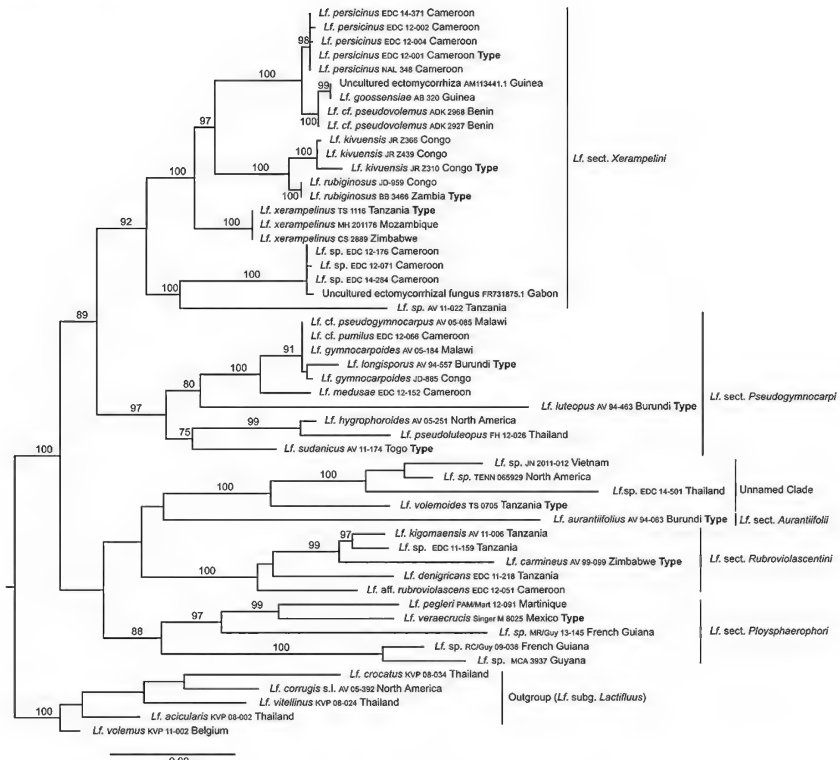
Lf. persicinus EDC 14-371 Cameroon
Lf. persicinus EDC 12-002 Cameroon
Lf. persicinus EDC 12-004 Cameroon
Lf. persicinus EDC 12-001 Cameroon Type
Lf. persicinus NAL 348 Cameroon
Uncultured ectomycorrhiza AM113441.1 Guinea
Lf. goossensiae AB 320 Guinea
Lf. cf. pseudovolemus ADK 2968 Benin
Lf. cf. pseudovolemus ADK 2927 Benin
Lf. kivuensis JR Z366 Congo
Lf. kivuensis JR Z439 Congo
Lf. kivuensis JR Z310 Congo Type
Lf. rubiginosus JD-959 Congo
Lf. rubiginosus BB 3466 Zambia Type
Lf. xerampelinus TS 1116 Tanzania Type
Lf. xerampelinus MH 201176 Mozambique
Lf. xerampelinus CS 2889 Zimbabwe
Lf. sp. EDC 12-176 Cameroon
Lf. sp. EDC 12-071 Cameroon
Lf. sp. EDC 14-284 Cameroon
Uncultured ectomycorrhizal fungus FR731875.1 Gabon
Lf. sp. AV 11-022 Tanzania
Lf. sect. Xerampelini
Lf. cf. pseudogymnocarpus AV 05-085 Malawi
Lf. cf. pumilus EDC 12-066 Cameroon
Lf. gymnocarpoides AV 05-184 Malawi
Lf. longisporus AV 94-557 Burundi Type
Lf. gymnocarpoides JD-885 Congo
Lf. medusae EDC 12-152 Cameroon
Lf. luteopus AV 94-463 Burundi Type
Lf. hygrophoroides AV 05-251 North America
Lf. pseudoluteopus FH 12-026 Thailand
Lf. sudanicus AV 11-174 Togo Type
Lf. sect. Pseudogymnocarpi
Lf. sp. JN 2011-012 Vietnam
Lf. sp. TENN 065929 North America
Lf.sp. EDC 14-501 Thailand
Lf. volemoides TS 0705 Tanzania Type
Lf. aurantiifolius AV 94-063 Burundi Type
Unnamed Clade
Lf. sect. Aurantiifolii
Lf. kigomaensis AV 11-006 Tanzania
Lf. sp. EDC 11-159 Tanzania
Lf. carmineus AV 99-099 Zimbabwe Type
Lf. denigricans EDC 11-218 Tanzania
Lf. aff. rubroviolascens EDC 12-051 Cameroon
Lf. sect. Rubroviolascentini
Lf. pegleri PAM/Mart 12-091 Martinique
Lf. veraecrucis Singer M 8025 Mexico Type
Lf. sp. MR/Guy 13-145 French Guiana
Lf. sp. RC/Guy 09-036 French Guiana
Lf. sp. MCA 3937 Guyana
Lf. sect. Ploysphaerophori
Lf. crocatus KVP 08-034 Thailand
Lf. corrugis s.l. AV 05-392 North America
Lf. vitellinus KVP 08-024 Thailand
Lf. acicularis KVP 08-002 Thailand
Lf. volemus KVP 11-002 Belgium
Outgroup (Lf. subg. Lactifluus)
0.09

FIG. 4. Overview Maximum Likelihood tree of *Lactifluus* subg. *Pseudogymnocarpi*, based on concatenated ITS and LSU sequence data. ML bootstrap values >70% are shown.

the species look alike; colours and lamellae are similar, as well as the fruit body shape, cap surface, and the latex. Microscopically they are also similar. The spore sizes correspond—7.9–*9.3–10.7*–13.8 × 5.9–*6.8–7.9*–9.0 µm (sister clade) vs. 6.9–*9.2–10.9*–12.8 × 5.7–*6.7–7.7*–9.4 µm (*Lf. persicinus*)—as do the spore shapes—Q = 1.18–*1.35–1.39*–1.66 (sister clade) vs. Q = 1.10–*1.33–1.48*–1.70 (*Lf. persicinus*). Basidia sizes overlap—55–90 × 9.5–11.5 µm (sister clade) vs. 45–74(–90) × (8–)8.5–11.5(–12.5) µm (*Lf. persicinus*). However, the average basidial length differs substantially—74 × 10 µm (sister clade) vs. 56 × 10 µm (*Lf. persicinus*). So the sister clade has on average much longer and more slender basidia than *Lactifluus persicinus*. Collections of the sister clade also have similar sterile elements, which are often septate and slightly thick-walled, and the terminal elements of the pilei- and stipitipellis also look alike. In addition, they were collected in the same kind of habitat, namely in gallery

forests. However, all currently known collections from *Lactifluus persicinus* were found in gallery forests dominated by *Uapaca guineensis,* while the three sister clade collections were found in gallery forests dominated by *Uapaca somon* [= *U. togoensis* Pax].

In summary, while morphologically very similar, these species are genetically distinct and can be morphologically distinguished from each other when the average basidium length is compared. These species could be considered pseudocryptic species; at first they seemed indistinguishable, but after the phylogeny revealed two distinct species, detailed morphological study revealed (a) character(s) that can be used to morphologically distinguish them from each other. This phenomenon is widespread throughout *Lactifluus* and considered typical for this genus with its high molecular diversity and relatively low morphological diversity. Many species complexes occur in *Lf.* subg. *Lactifluus*, *Lf.* subg. *Gymnocarpi*, *Lf.* sect. *Pseudogymnocarpi*, etc. (De Crop 2016, Stubbe 2012, Van de Putte 2012) and as with most of these, the genetic distance between *Lactifluus persicinus* and its sister clade is rather low, as can be seen from the short—although well-supported—branches between them (Fig. 4). This may suggest a relatively recent divergence between species as well as insufficient time for significant morphological divergence to develop.

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Distoceratosporella digitiformis gen. & sp. nov. from Brazil, *Alcornia sessilispora* gen. & comb. nov., and three new *Distoceratosporella* combinations

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Abstract—*Alcornia* is proposed as a new monotypic genus differentiated from *Parapericonia* by its tretic conidiogenous cells and rhexolytic conidial secession; a new combination *Alcornia sessilispora* is also proposed, based on *P. sessilispora*. *Distoceratosporella digitiformis* is proposed as a new genus and species distinguished from *Ceratosporella* by its distoseptate conidia. These taxa are described and illustrated. Additionally, the new combinations *Distoceratosporella amazonica*, *D. hernandezii*, and *D. longiramosa* are proposed, all with *Ceratosporella* basionyms.

Key words—*Ascomycota,* conidial fungi, hyphomycetes, taxonomy, tropics

Introduction

The diversity of conidial fungi in the Brazilian semiarid region has received little attention. During a survey of hyphomycetes associated with plant materials from Bahia state, two conspicuous fungi were collected. One fungus showed remarkable differences from all previously described genera (Seifert et al. 2011), and the second, although an identifiable species, differed significantly

from all other species of the genus in which it had originally been described. The two species are proposed here as the types of two new genera, *Alcornia* and *Distoceratosporella*.

Materials & methods

Samples of leaf litter and decaying fruits were collected in Abaíra and Serra do Ramalho, Bahia state, Brazil. The samples were placed in paper bags for transport to the laboratory, where they were placed in Petri dish moist chambers and stored at 25°C for 30 days in a 170 L polystyrene box with 200 mL sterile water plus 2 mL glycerol (Castañeda-Ruiz et al. 2016). Mounts were prepared in PVL (polyvinyl alcohol and lactic acid) and measurements were made at a ×1000 magnification. Micrographs were obtained with an Olympus BX51 microscope equipped with bright field and Nomarski interference optics. The specimens, including the holotype, are deposited in the Herbarium of Universidade Estadual de Feira de Santana, Bahia, Brazil (HUEFS).

Taxonomy

Alcornia J.S. Monteiro, S.M. Leão, Gusmão, P.M. Kirk & R.F. Castañeda, **gen. nov.**

Index Fungorum IF 553580

Differs from *Parapericonia* by its tretic conidial ontogeny and rhexolytic conidial secession

Type species: *Parapericonia sessilispora* Alcorn & P.M. Kirk [≡ *Alcornia sessilispora* (Alcorn & P.M. Kirk) J.S. Monteiro et al.]

Etymology: Latin, *Alcornia*, named in honor to John L. Alcorn, an Australian mycologist for his contribution to the study of fungal diversity.

Conidiomata on the natural substratum sporodochial, punctiform, scattered; brown, dark brown, or black. Conidiophores macronematous, mononematous, erect, unbranched or slightly branched, cylindrical, with a distinct constriction near the base, flexuous, sub-coiled, undulated, septate, verruculose, pale brown or brown. Conidiogenous cells polytretic, integrated cylindrical, determinate, intercalary, rarely terminal, brown. Conidial secession rhexolytic. Conidia solitary, pleurogenous, globose, unicellular, verruculose or verrucose with a basal frill, dark brown to dark reddish-brown.

Alcornia sessilispora (Alcorn & P.M. Kirk) J.S. Monteiro, S.M. Leão, Gusmão, P.M. Kirk & R.F. Castañeda, **comb. nov.** Fig. 1

Index Fungorum IF 553581

≡ *Parapericonia sessilispora* Alcorn & P.M. Kirk, *Trans. Br. Mycol. Soc.* 85(3): 561 (1985).

Conidiomata on the natural substratum rudimentary sporodochial, punctiform, scattered; brown, dark brown or black. Mycelium mostly superficial, composed of septate, verruculose, somewhat leprous, brown

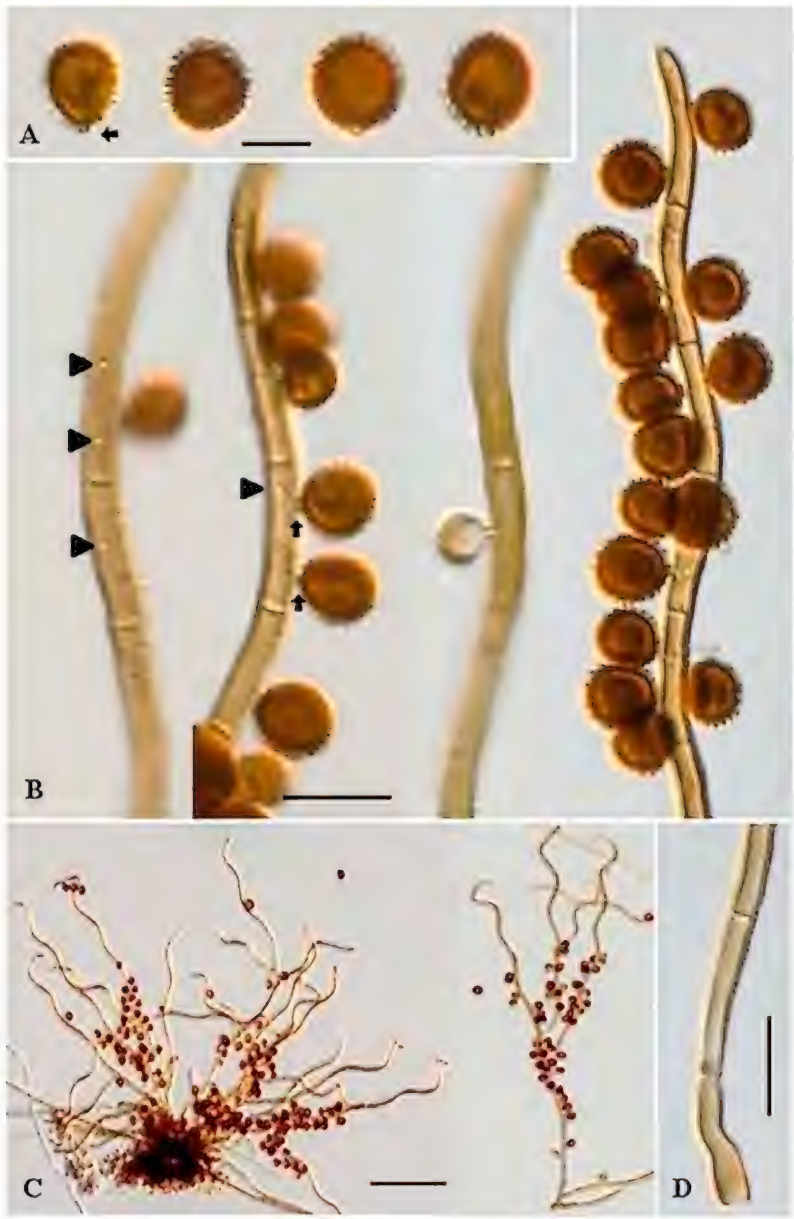

Fig. 1. *Alcornia sessilispora* (HUEFS 210449). A. Conidia with small peg (arrow). B. Detail of conidiogenous cells with pores (arrows head) and conidia with small peg (arrow). C. General aspect of conidiophores. D. Detail of basal cell of conidiophore. Scale bars: A = 5 µm; B, D = 10 µm; C = 50 µm.

hyphae, 2–4 µm diam. Conidiophores macronematous, mononematous, arising in fascicles from the conidiomata, erect, unbranched or slightly branched above, flexuous, sub-coiled, undulating toward the apex and distinctly constricted near the base, 8–14-septate, verruculose, pale brown to mid brown, <500 µm long, 5–6 µm wide, proximal part below the constriction 7–25 µm long. Conidiogenous cells polytretic, integrated, verruculose, cylindrical, determinate, intercalary, rare terminal, brown, 11–20 × 2.5–3.5 µm. Conidial secession rhexolytic. Conidia solitary, pleurogenous, globose, unicellular, verruculose or verrucose, 5–7 µm diam, dark brown to dark reddish-brown, with a pale brown, 1–1.5 µm long basal frill.

Specimen examined: **BRAZIL. Bahia**, Serra do Ramalho, on decaying fruit of unidentified plant, 13°32′S 43°47′W, alt. 450–600 m, 16 March 2008; coll. S.M. Leão-Ferreira (HUEFS 210449).

Comments: *Parapericonia* M.B. Ellis, typified by *P. angusii* M.B. Ellis, is characterized by pulvinate, punctiform sporodochial conidiomata arising from superficial and immersed stromata. The conidiophores are macronematous, mononematous, unbranched or branched, straight or flexuous, uncinate at the apex, constricted near the base, pale to mid brown, verruculose toward the apex. The conidiogenous cells are monoblastic or polyblastic, turbinate or clavate, discrete, laterally developed on the conidiophores and branches, solitary or short moniliform and produce solitary or blastocatenate, spherical, unicellular conidia verruculose, dark brown that seceding schizolytically (Ellis 1976). *Sporotretophora* Whitton et al. resembles *Alcornia* in its conidiophore arrangement, enteroblastic tretic conidiogenesis, and unicelled conidia; but *Sporotretophora* has monotretic conidiogenous cells and schizolytic secession of conidia (Whitton et al. 2012).

The conidiomata in *Alcornia* are considered rudimentarily sporodochial but lacking immersed or superficial stromata and with the conidiophores arising more or less in a radial fascicle from a tuft formed by branched and anastomosing hyphae. Its conidiogenous cells are polytretic, integrated, intercalary, and the conidia attach to the conidiogenous loci by a diminutive peg, 1–1.5 µm long that remains attached to the conidia after rhexolytic conidial secession. The three important diagnostic characters separating *Alcornia* from *Parapericonia* include: a) integrated (not moniliform) conidiogenous cells, b) tretic conidiogenous cells, and c) rhexolytic conidial secession (Alcorn & Kirk 1985). These differences support a new genus and new combination for *Parapericonia sessilispora*.

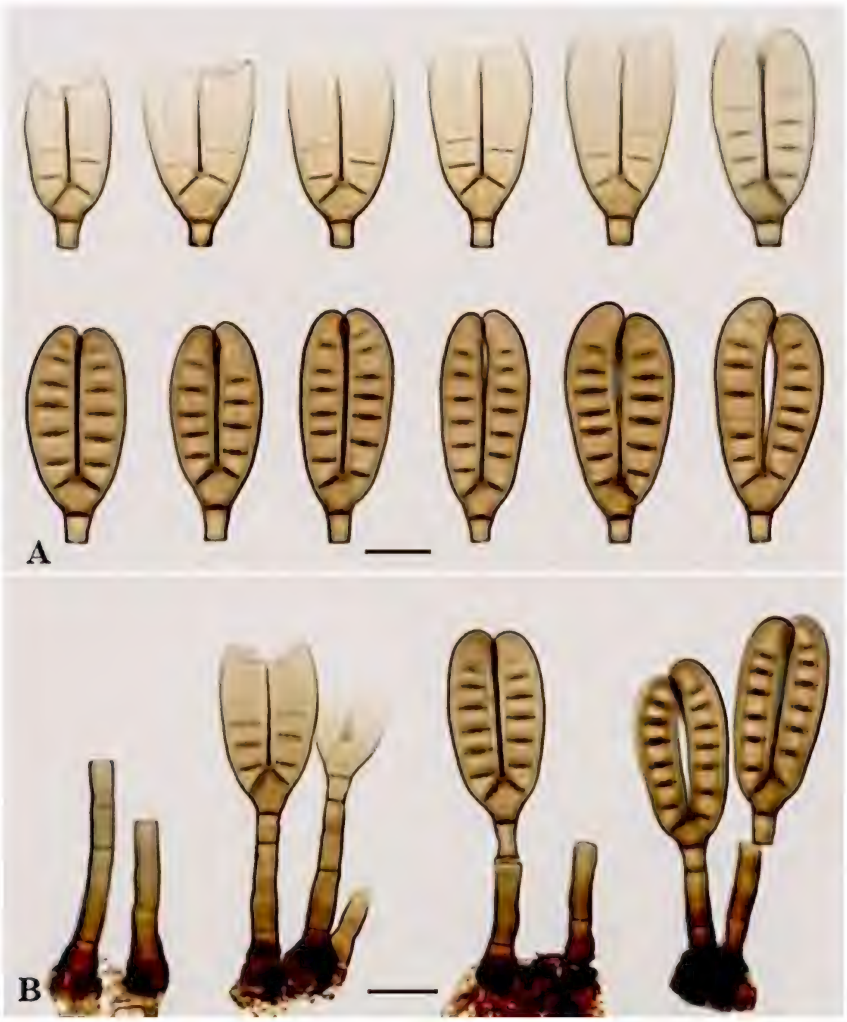

FIG. 2. *Distoceratosporella digitiformis* (holotype, HUEFS 216663). A. Conidia. B. Conidiophores, conidiogenous cells, and conidia. Scale bars = 10 μm.

Distoceratosporella J.S. Monteiro, Gusmão & R.F. Castañeda, **gen. nov.**

INDEXFUNGORUM IF553582

Differs from *Ceratosporella* by its distoseptate conidia.

TYPE SPECIES: *Distoceratosporella digitiformis* J.S. Monteiro et al.

ETYMOLOGY: Latin, *disto-*, referring to the type of septa, + *-ceratosporella* referring to the genus *Ceratosporella*.

Conidial fungi. Colonies on the natural substratum effuse; brown, dark brown, or black. Conidiophores macronematous, mononematous, erect, unbranched, septate, brown or black. Conidiogenous cells monoblastic, cylindrical, integrated, with enteroblastic, percurrent extensions, brown. Conidial secession schizolytic. Conidia solitary, acrogenous, stauroconidium or cheiroid, with 2 or more distoseptate rows of cells, pale brown to dark brown, smooth or verrucose.

Distoceratosporella digitiformis J.S. Monteiro, Gusmão, & R.F. Castañeda, **sp. nov.** Figs 2, 3c

Index Fungorum IF 553583

Differs from *Ceratosporella bicornis* and all other *Ceratosporella* spp. by its distoseptate, digitiform conidia.

Type: **BRAZIL. Bahia**: Abaíra, Mata da Tijuquinha (Catolés), on decaying leaves of unidentified plant, 13°13′S 41°37′W, 9 January 2015, coll. J.S. Monteiro (**Holotype**: HUEFS 216663).

Etymology: Latin, *digitiformis*, meaning finger-like, referring to the two rows of cells in the conidia.

Colonies on the natural substratum effuse, hairy, dark brown. Mycelium mostly superficial, composed of branched, smooth, brown hyphae, 2–3 µm diam. Conidiophores macronematous, mononematous erect, straight, unbranched, 1–4-septate, 20–40 × 3–4 µm, brown to dark brown at the base, pale brown toward the apex, smooth. Conidiogenous cells monoblastic, cylindrical or doliiform, integrated, indeterminate with 1–3 enteroblastic percurrent extensions, pale brown, smooth, 4–15 × 3.5–4 µm. Conidial secession schizolytic. Conidia acrogenous, solitary, 32–43 × 12–16 µm, digitiform, with a doliiform or very short cylindrical basal cell, 4–6 × 3–4 µm, brown, smooth, composed of two parallel, cylindrical, brown, 4–8-distoseptate, smooth row of cells, 18–32 × 6–8 µm.

Comments: *Ceratosporella* Höhn., typified by *Tripsporium bicorne* Morgan [≡ *C. bicornis* (Morgan) Höhn.] (Fig. 3a), is distinguished by macronematous, mononematous, unbranched conidiophores and monoblastic, cylindrical or doliiform, terminal, integrated conidiogenous cells with one or several enteroblastic percurrent extensions. The conidia are solitary, acrogenous, stauroconidia or cheiroid, euseptate, brown. The remaining 13 *Ceratosporella* species have euseptate conidia, agreeing with the generic concept provided by Höhnel (1923) and treated by Castañeda-Ruiz et al. (1996), Kuthubutheen & Nawawi (1991), Monteiro & Gusmão (2014). *Distoceratosporella* closely

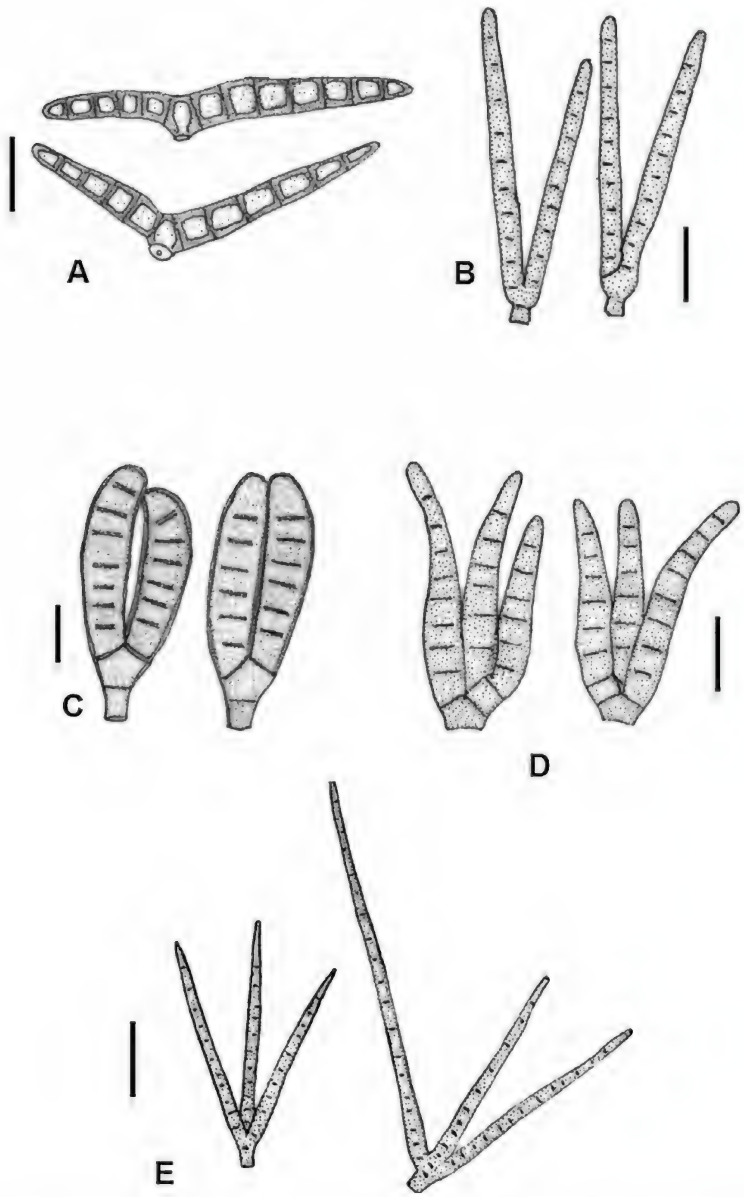

FIG. 3. *Ceratosporella* and *Distoceratosporella* species: conidia of type specimens. A. *Ceratosporella bicornis* (Hughes 1951); B. *Distoceratosporella amazonica* (Monteiro & Gusmão 2014); C. *Distoceratosporella digitiformis* (this paper); D. *Distoceratosporella hernandezii* (Monteiro & Gusmão 2014); E. *Distoceratosporella longiramosa* (Castañeda-Ruiz 1988). Scale bars: A, B, D, E = 20 μm; C = 10 μm.

resembles *Ceratosporella* but can be separated by its distoseptate conidia. Similar criteria have been used to separate other generic pairs, such as *Corynespora* Güssow and *Solicorynespora* R.F. Castañeda & W.B. Kendr., *Sporidesmiella* P.M. Kirk and *Sporidesmium* Link, *Ellisembia* Subram. and *Sporidesmium*, and *Minimelanolocus* R.F. Castañeda & Heredia and *Pseudospiropes* M.B. Ellis (Castañeda-Ruiz & Kendrick 1990, Kirk 1982, Subramanian 1992, Castañeda-Ruiz et al. 2001).

New combinations for three *Ceratosporella* species are proposed in *Distoceratosporella*, based on their distoseptate conidia:

Distoceratosporella amazonica (J.S. Monteiro & Gusmão) J.S. Monteiro, Gusmão & R.F. Castañeda, **comb. nov.** Fig. 3b

Index Fungorum IF 553584

≡ *Ceratosporella amazonica* J.S. Monteiro & Gusmão, Nova Hedwigia 98: 483 (2014).

Distoceratosporella hernandezii (J.S. Monteiro & Gusmão) J.S. Monteiro, Gusmão & R.F. Castañeda, **comb. nov.** Fig. 3d

Index Fungorum IF 553585

≡ *Ceratosporella hernandezii* J.S. Monteiro & Gusmão, Nova Hedwigia 98: 483 (2014).

Distoceratosporella longiramosa (R.F. Castañeda) R.F. Castañeda, J.S. Monteiro & Gusmão, **comb. nov.** Fig. 3e

Index Fungorum IF 553586

≡ *Ceratosporella longiramosa* R.F. Castañeda, Fungi Cubenses III: 2 (1988).

≡ *Actinocladium longiramosum* (R.F. Castañeda) R.F Castañeda, Mycotaxon 60: 278 (1996).

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We are indebted to Dr. Jian Ma and Dr. De-Wei Li for critical review. The authors thank the National Council for Scientific and Technological Development (CNPq) (Proc. 451991/2016-8; 303062/2014-2; 154329/2016-9). RFCR is grateful to OSDE, Grupo Agrícola from Cuban Ministry of Agriculture and Programa de Salud Animal y Vegetal (project P131LH003033). Dr. Lorelei L. Norvell's editorial review and Dr. Shaun Pennycook's nomenclature review are greatly appreciated.

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First report of *Colletotrichum fioriniae* infection of hazelnut

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Abstract—In a 2008–09 study of hazelnut fruit cluster diseases in Ordu, Giresun, and Trabzon provinces of Turkey, brown to black sunken, circular to irregular lesions and rots were observed, usually at the bottom end of the hazelnut cluster, close to the pedicel. *Colletotrichum* species were most frequently isolated from the lesions, and 13 isolates were identified morphologically as *C. fioriniae*, and the identity of one of them was confirmed by molecular analyses. Pathogenicity tests were conducted under laboratory, greenhouse, and field conditions, and symptoms matching the original field symptoms were observed on leaves, fruit clusters, and pedicels. This is the first report of *C. fioriniae* as a pathogen of hazelnut (*Corylus avellana*) and the first record of *C. fioriniae* from Turkey.

Key words—Black Sea region, *Colletotrichum acutatum*, *Glomerellaceae*

Introduction

Hazelnut (*Corylus avellana* L.) is one of the most important tree nut crops in Turkey, which with 80% of world production is the leading exporter of hazelnuts (FAOSTAT 2011). Hazelnut production in Turkey in the Black Sea region extends from the Georgia border in the east to Istanbul in the west. Surveys were carried out in 2008–09, on 221 hazelnut orchards located at Ordu, Giresun, and Trabzon provinces in the Black Sea region of Turkey (Fig. 1). Almost 50% of the surveyed orchards had symptomatic clusters with brown to black sunken, circular to irregular lesions that can progress from husk into fruit

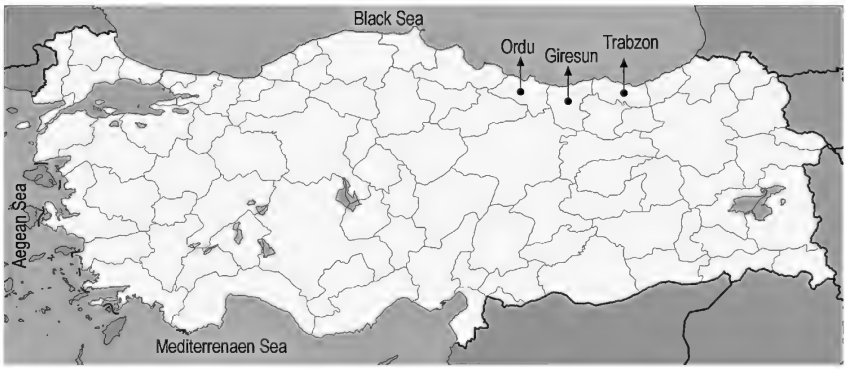


Fig. 1: Provinces surveyed for fruit cluster disease of hazelnut in Turkey.

(Figs 2–4). *Colletotrichum* was the predominant genus isolated (Sezer & Dolar 2012), and 13 morphologically similar isolates were provisionally determined as *C. fioriniae*.

Colletotrichum fioriniae has not previously been reported as a pathogen of hazelnut or from Turkey.

Materials & methods

Fungal isolates

During 2008–09, fungi were isolated from symptomatic clusters from different cultivars and locations (Sezer & Dolar 2012). Infected fruit clusters were surface-sterilized (0.5–1% w/v sodium hypochlorite) for 1–2 min before being placed onto potato dextrose agar (PDA, Merck) containing streptomycin. Single spore isolates were obtained from fungal cultures incubated at 23 ± 1°C with a 12 h photoperiod for 3–5 days and stored on PDA slants in tubes at 4°C. Cultures were conserved in the Department of Plant Protection, Ankara University, Ankara, Turkey (AUPP) and the Hazelnut Research Institute, Giresun, Turkey (HRI).

Identification of fungus

Culture morphology, growth rate, and conidial morphology were observed from 7–10-day old cultures grown on PDA (Sutton 1980, Marcelino et al. 2008, Cai et al. 2009, Hyde et al. 2009a,b, Shivas & Tan 2009). Mycelial appressorial characters were observed from slide cultures on Potato Carrot Agar (PCA) (Sutton 1980). Shape, length, and width of 100 conidia were measured and mean length and width were calculated. Initial morphological fungal identification was confirmed by CABI-UK, who sequenced the internal transcribed spacer (ITS) of the rRNA gene of isolate P39.

Additional analyses were made of partial sequences of the beta-tubulin-2 (β-tub), glyceraldehyde 3-phosphate dehydrogenase (GAPDH), and chitin synthase-1 (CHS-1)

Figs 2–4: *Colletotrichum fioriniae*: field symptoms. 2. Small lesions on husk. 3. Large lesions on bottom end of the fruit cluster. 4. Brownish black lesion on fruit shell under the symptomatic husk.

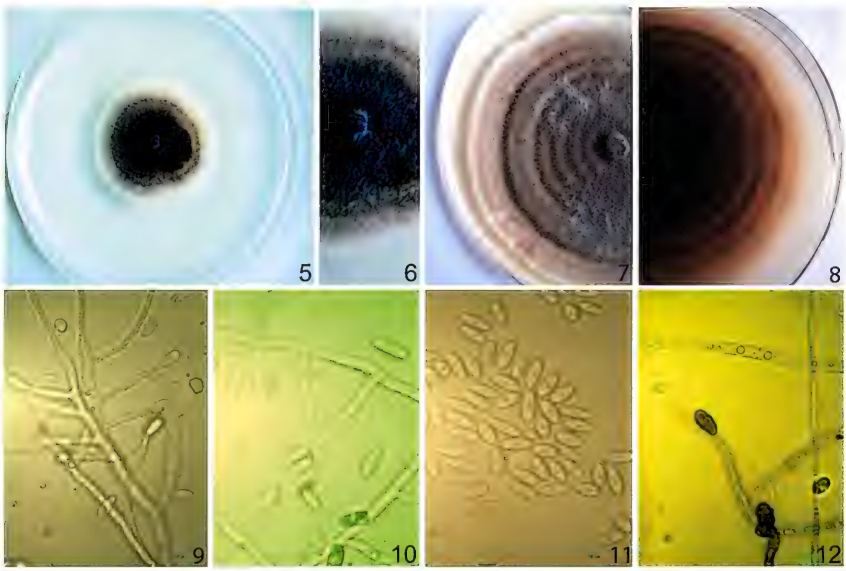
genes (Damm et al. 2009, 2012a,b, 2014; Weir et al. 2012), using universal primers T1/βt2b for β-tub, GDF1/GDR1 for GAPDH, and CHS1-79F/CHS1-354R for CHS-1 (Glass & Donaldson 1995, Carbone & Kohn 1999, Guerber et al. 2003). For DNA extraction approximately 300 mg mycelium were harvested and ground with liquid nitrogen in a sterile mortar from culture medium. Genomic DNA was extracted using a Qiagen DNeasy ® Plant Mini Kit, as specified by the manufacturer, and stored at –20°C prior to use. PCR reaction mixtures and condition were modified from previous studies (Aroca & Raposo 2007, Cobos & Martin 2008). The reaction mixtures of PCR, a final volume of 50 µl, contained 5µl of 10X buffer [75 mM Tris HCl, pH 9.0, 50 mM KCl, 20 mM $(NH_4)2SO_4$], 2 µl of 5 µM each primers, 5 µl of 1.5mM $MgCl_2$, 2 µl of 10 mM deoxynucleoside triphosphates (dNTPs), 1 U Taq polymerase (Fermatas), 5 µl of DNA template for each reaction and 5 µl of bovine serum albumin (BSA: 10 mg/ml). DNA amplifications were carried out in a Techne TC-5000 thermal cycler by the following program: 94°C for 2 min, followed by 34 cycles of [denaturation (94°C for 30 s), annealing (60°C for 30 s), and (3) extension (72°C for 30 s)], and a final extension step 10 min at 72°C. Sequencing was conducted by Genoks (Ankara, Turkey). The nucleotide sequences were subjected to BLAST analysis (http://www.ncbi.nlm.nih.gov) and compared to other sequences in GenBank using CLC Main Workbench 7.0.1 (CLC Bio, Denmark). Our new sequences were deposited in GenBank.

Pathogenicity tests

Pathogenicity tests were conducted on Tombul and Kalınkara hazelnut cultivars using detached leaves in the laboratory, detached twigs and clusters in the greenhouse, and attached twigs in the orchard according to Sezer & Dolar (2012).

Disease assessment

For disease assessment, percentage surface area covered by lesions on leaf or fruit cluster of hazelnut was determined. Disease severity was calculated by estimating lesion sizes on a scale of 0 to 3, where 0 = no lesions, 1 = 1–30% of tissues affected, 2 = 31–60% of tissues affected, and 3 = >60% of tissues affected. These scale values were converted to



Figs 5–12: *Colletotrichum fioriniae*. 5. 5-day old colony on PDA. 6. Enlarged view of spore masses on a 5-day old colony. 7. 10-day old colony on PDA. 8. Reverse side of 10-day old colony. 9. Unicellular conidiophores. 10. Septate conidiophores. 11. Conidia. 12. Appressoria. Scale bars = 10 µm.

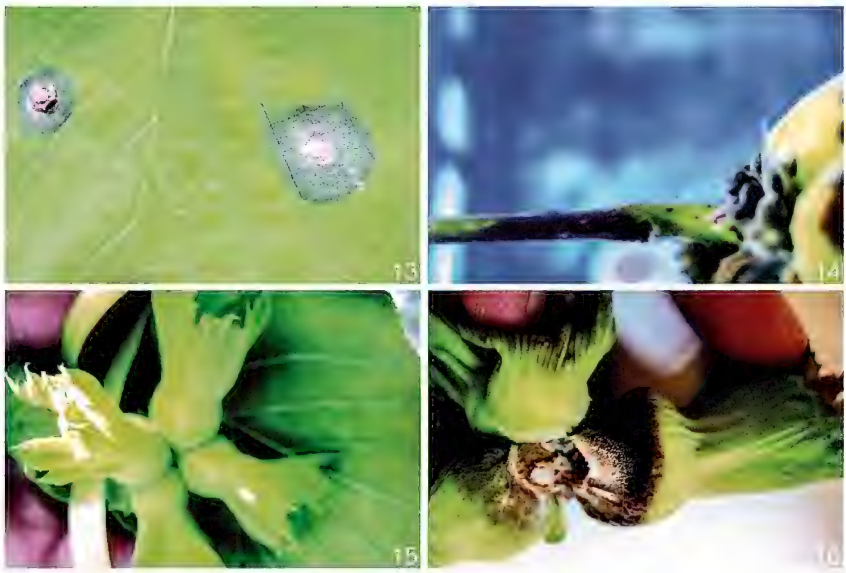
disease severity values (Xi et al. 1990) based on the formula: Disease Severity % = 100 × Σ(no. of plants in category × category number) / (total no. of plants × max. category number).

Results & discussion

With a 30.41% frequency among 217 fungal isolates, *Colletotrichum* was the main genus isolated from symptomatic fruit clusters. Of the thirteen *Colletotrichum* isolates evaluated showing similar cultural and morphological characteristics, one (P39) was also confirmed as *C. fioriniae* by phylogenetic analyses.

Colletotrichum fioriniae (Marcelino & Gouli) Pennycook,
Mycotaxon 132(1): 150. 2017. Fig. 5–12
≡ *Glomerella acutata* var. *fioriniae* Marcelino & Gouli, Mycologia 100: 362. 2008.

Single spore isolates developed colonies on PDA 48.6 mm diam. after 7 days and 71.3 mm diam. after 10 days; the 7–10-day old colonies were circular, slightly raised, dense, and cottony with aerial mycelium in compact tufts



Figs 13–16. *Colletotrichum fioriniae*: hazelnut pathogenicity test symptoms. 13. On detached leaf. 14. On pedicel of the fruit cluster on detached twig. 15. Appearance of fruit cluster 20 days after inoculation (symptomless) in orchard. 16. Symptom on fruit cluster at harvest time in orchard.

and no distinct acervuli. Rarely observed conidial masses were salmon pink. Surface colony color was greenish gray-pink, reverse was pale brown to pink. While the first single spore isolate cultures on PDA were distinctly pink, the color became less intense with subsequent subculturing. Sclerotia and setae were absent. Mycelia were branched, septate, hyaline. Conidiophores formed directly on hyphae, 22.9 ± 1.7 × 2.6 ± 0.1 µm (mean), hyaline, cylindrical, usually unicellular and occasionally branched. Conidia in masses were 11.4 ± 0.2 × 4.1 ± 0.1 µm, hyaline, guttulate, aseptate, straight, usually ellipsoid to fusiform and acute at both ends. Mycelial appressoria (rare in slide cultures) measuring 8.3 ± 0.2 × 5.4 ± 0.1 µm, pale to dark brown, clavate or slightly irregular.

Specimens examined: **TURKEY, Ordu Province, Perşembe district**, Mersin village, from rotting *Corylus avellana* fruit cluster, July 2008, Arzu Sezer P39 (AUPP, HRI; culture, IMI 500303; GenBank KU736863, KU736864, KU736865).

These morphological characteristics matched the description of *Colletotrichum fioriniae* (Marcelino et al. 2008, as *C. acutatum* var. *fioriniae;* Shivas & Tan 2009), and the rRNA gene ITS sequence from *C. fioriniae* isolate P39 was confirmed

as *C. fioriniae* by CABI-UK (IMI 500303). Damm et al. (2012a) recommended that both β-tub and GAPDH genes were suitable for identification of species belonging to the *C. acutatum* complex. BLAST of the DNA sequences obtained from three different gene regions of the isolate P39 showed a high identity (>99%) with previously deposited authentic sequences of *C. fioriniae* in GenBank: β-tub—JN121279, AB690809, GU183268, GU183272, KJ955322, KJ650030; GAPDH—KM252213, KM252196, KF944354, KJ954876; CHS-1—JQ948954, KT153547.

Pathogenicity tests showed that *C. fioriniae* produced large circular lesions on leaf surface. On detached twigs and clusters it caused elongate lesions on the pedicel producing salmon-orange spore masses. At the orchard, no symptoms were observed in inoculated fruit clusters near harvest time. At harvest three months after inoculation, large brown necrotic areas with salmon-orange spore masses on bottom ends of fruit clusters were observed (Figs 13–16). The fungus was re-isolated from all diseased tissues. No symptoms were observed on the controls. Disease severity on detached leaves was 33.33% on Tombul cultivar and 50% on Kalinkara cultivar, 77.78% on detached twigs and clusters, and 41.67% on fruit clusters in the orchard inoculations.

Marcelino et al. (2008) originally described *Colletotrichum fioriniae* as a variety of *C. acutatum* (with a sexual morph, *Glomerella acutata* var. *fioriniae*), and Shivas & Tan (2009) proposed that the *Colletotrichum* and *Glomerella* names should both be elevated to species rank. Unfortunately, only one of these four names was validly published; subsequently, *C. fioriniae* has been validly published, based on the valid basionym *G. acutata* var. *fioriniae* (Pennycook 2017). According to Shivas & Tan (2009) *C. fioriniae* is morphologically similar to *Colletotrichum acutatum* J.H. Simmonds, which differs by having colonies on PDA with a grey cottony aerial mycelium (pale brownish pink with dark flecking in reverse); sparse conidiomata with masses of orange conidia; and narrowly elliptical conidia, 9–15 × 3–4.5 µm.

Previously, *Colletotrichum acutatum* was identified as a pathogen on hazelnut fruit clusters with same symptoms described here in Turkey (Sezer & Dolar 2012); *C. gloeosporioides* (Penz.) Penz. & Sacc. was identified as a pathogen on leaves and stems of hazelnut in Iran (Mirhosseini-Moghaddam & Taherzadeh 2007); and *Colletotrichum* sp. (among other fungi) was isolated from hazelnut flowers/fruits affected by a disease named gray necrosis in Italy (Belisario & Santori 2009). To our knowledge, this is the first report of *C. fioriniae* as a pathogen of *Corylus avellana*. This is also the first report of *C. fioriniae* infection of a crop plant in Turkey.

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New *Calbovista, Mycena, Rhizopogon, Stictis,* and *Symphyosirinia* records from Turkey

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Abstract—*Calbovista subsculpta*, *Mycena pearsoniana*, *Rhizopogon rocabrunae*, *Stictis radiata*, and *Symphyosirinia angelicae* were identified amongst macrofungal samples collected from natural habitats in Tokat and Samsun provinces between 2012 and 2015. These species are recorded for the first time from Turkey.

Key words—ascomycetes, basidiomycetes, macrofungi, taxonomy

Introduction

Checklists of larger fungi recorded in Turkey have been published by Sesli & Denchev (2014) and Solak et al. (2015) with new records added to the Turkish mycota reported in other papers (Akata et al. 2014; Akata & Doğan 2015, Doğan & Öztürk 2015, Güngör et al. 2015, Kaya & Uzun 2015, Kaya 2015, Sesli et al. 2015, Sesli & Moreau 2015, Türkoğlu et al. 2015, Uzun et al. 2015).

Field studies were conducted during 2012–2015 in Tokat province (Canpolat Plateau; Baydarlı Village) and Samsun province (Ladik district) in the inland Middle Black Sea Region of Turkey. The Canpolat Plateau (alt. c. 1300 m) is a rugged semi-arid highland area with mixed forests dominated by *Quercus pubescens* and *Carpinus orientalis*. The Baydarlı village area (alt. c. 1500 m) also has mixed forests dominated by *Quercus pubescens* but a drier climate. The Ladik district (alt. c. 1400 m) is a highland area with mixed forests dominated by *Pinus nigra*.

Sesli & Denchev (2008) have attributed the high mushroom diversity to this region to its ecological characteristics, climate, and high ambient humidity. The aim of this study was to explore the diversity of mushrooms in the area and add to the knowledge of the Turkish mycota.

We describe and illustrate below our collections representing species reported for the first time from Turkey: *Calbovista subsculpta* (*Agaricaceae*), *Mycena pearsoniana* (*Mycenaceae*), *Rhizopogon rocabrunae* (*Rhizopogonaceae*), *Stictis radiata* (*Stictidaceae*), and *Symphyosirinia angelicae* (*Helotiaceae*).

Materials & methods

Macrofungi were collected from Canpolat and Baydarlı (Tokat), and Ladik (Samsun) areas between 2012 and 2015. The habitat and morphological characteristics of the macrofungal specimens were recorded and photographed with a Canon EOS 600 D digital camera equipped with a macro lens. The collections were examined microscopically at Gaziosmanpaşa University according to Clémençon (2009). The specimens were sectioned with a new razor blade under a Nikon Optiphot-2 microscope; sections were mounted in diluted ammonia, stained with Melzer's reagent, Congo red, or Cotton blue, and examined under a Nikon trinocular microscope. Species were identified after consultation with the literature (Phillips 1981; Moser 1983; Bon 1987; Breitenbach & Kränzlin 1984, 1991, 2000; Ellis & Ellis 1990; Jordan 2004; Knudsen & Vesterholt 2008). All samples were stored in the Fungarium of Department of Biology, Gaziosmanpaşa University, Tokat, Turkey (FGOU).

Taxonomy

Calbovista subsculpta Morse ex M.T. Seidl, Mycotaxon 54: 390 (1995) Fig. 1

Fruit body 70–140 mm broad, ≤80–90 mm high; plicate and contracted toward a rooting base, globose to pear shaped. Exoperidium whitish yellow to cream when young, the color then turns to yellow with the appearance of white patches in yellow through maturation, 5.5–7.5 mm high, breaking up into pyramidal warts or plates separated by parallel transverse lines; small truncated pyramids leathery, broken into irregular 1.5–3.5 mm patches, short brownish hairs found in the pyramid centers. Endoperidium white to cream when young, then yellow to orange, and finally dark brown in age. Gleba white to cream, becoming ochre to olivaceus, finally brown. Basidiospores 3.5–5 µm diam. (occasionally ovate), hyaline, most with a central oil-droplet.

Specimen examined: **TURKEY, Tokat,** Baydarlı village, 40°57′09″N 37°29′50″E, 1632 m, single to gregarious in subalpine open areas near forest edge, 28 April 2013, leg. I. Türkekul (FGOU 3927).

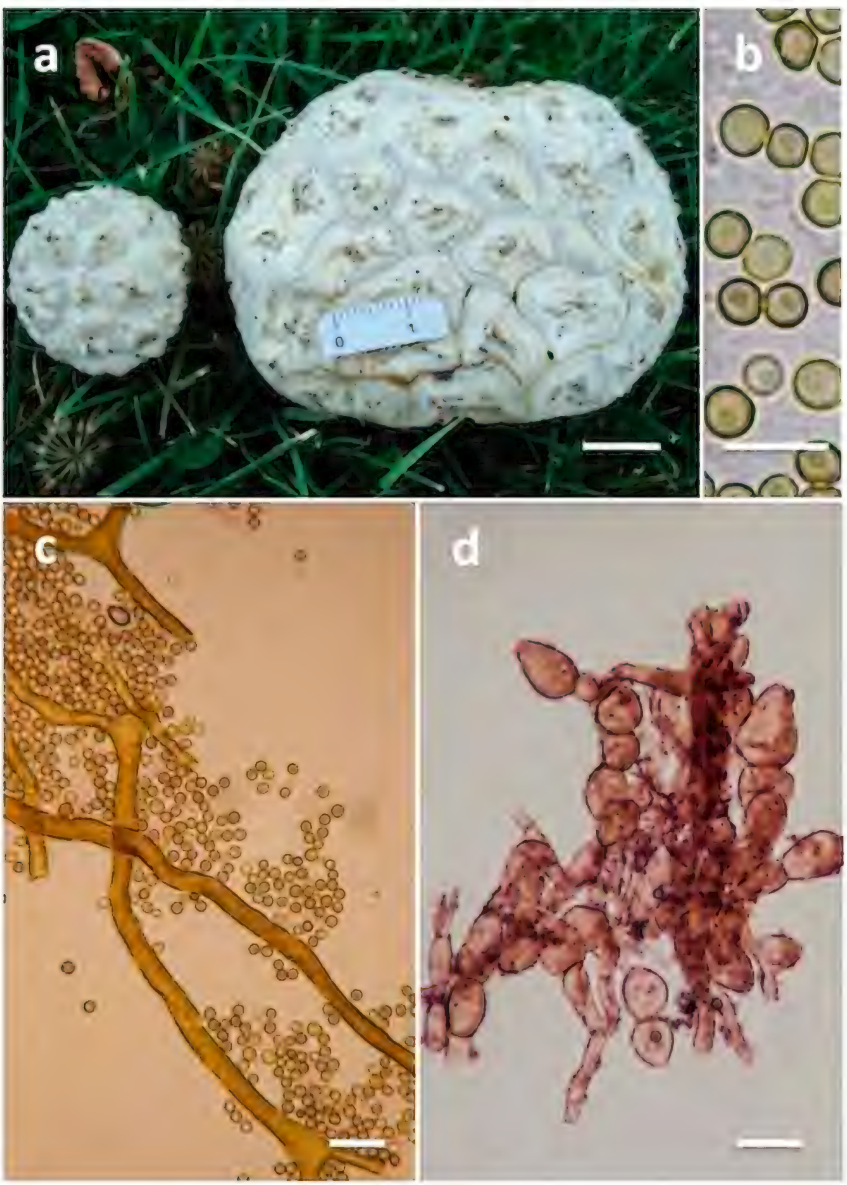

Fig. 1. *Calbovista subsculpta*: a. basidiomata; b. basidiospores; c. basidiospores and capillitial threads; d. pileipellis. Scale bars: a = 10 mm; b = 10 µm; c, d = 20 µm.

Comments—The genus *Calbovista,* which comprises only three species, has not previously been recorded from Turkey, thus making our report of *C. subsculpta* a new record for the country at both the specific and generic levels. It is diagnosed by the presence of nested pyramids on the cap, with the outer pyramid taller and the inner ones shorter, irregular shaped, truncate, and leathery. Generally found above 900 m elevation, occasionally in alpine areas of disintegrated rock and soil mix (Ramsey 2003). Our samples were also collected in alpine areas at 1632 m.

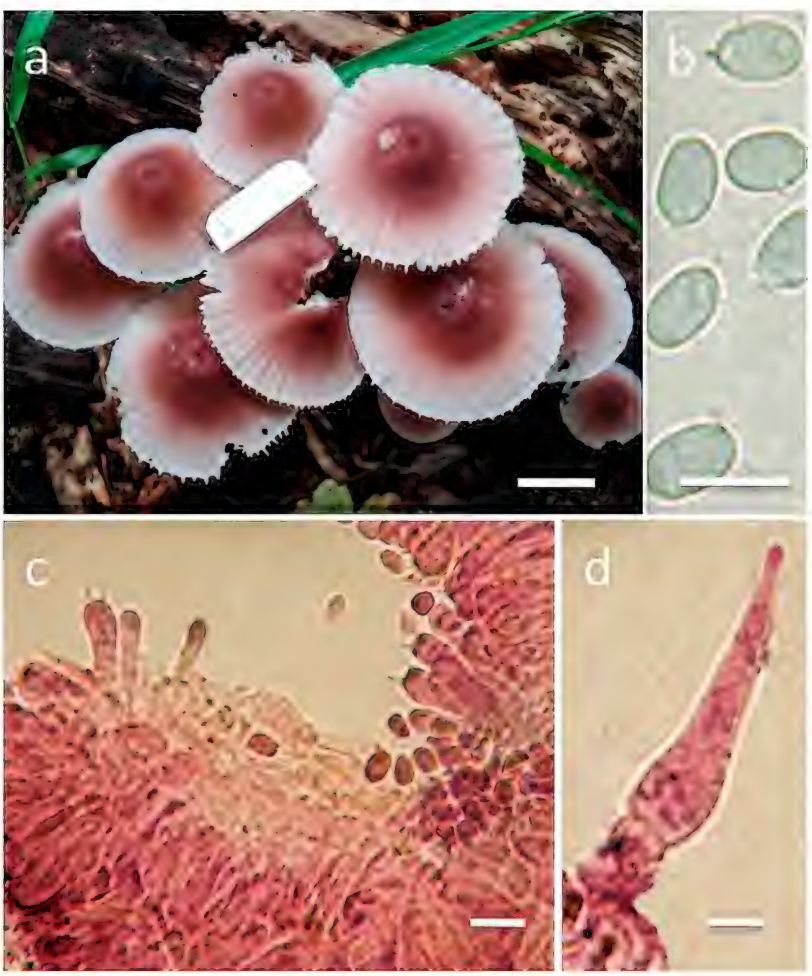

Fig. 2. *Mycena pearsoniana*: a. basidiomata; b. basidiospores. c. basidia; d. cheliocystidia. Scale bars: a = 10 mm; b–d = 10 µm.

Mycena pearsoniana Dennis ex Singer, Sydowia 12: 233 (1959) Fig. 2

Pileus 10–30 mm across, convex, flattening with age, becoming plano-convex, violet pinkish tints, paler at margin. Stipe 30–55(–75) × 1.5–3 mm, cylindrical or slightly enlarged toward base, smooth, moist, villose at base, cinnamon at apex, fragile to firm, Taste mild or rancid, smell raphanoid. Lamellae close, narrow, adnate, whitish flushed violet. Pleurocystidia absent. Cheilocystidia 35–65 × 7–13 µm, cylindric with rounded apex, smooth. Spore print white. Basidia 25–30 × 5–7 µm, clavate to cylindric. Basidiospores 6–8 × 3.5–5 µm, inamyloid, pip-shaped.

Specimen examined: **TURKEY, Tokat,** Canpolat village, 40°33′55″N 36°36′48″E, 1245 m, on a rotten stump of *Picea orientalis*, 12 November 2012, leg. I. Türkekul (FGOU 3862).

Comments—*Mycena* is represented by 2186 species worldwide (www.indexfungorum.org; 15 December 2016) and 60 species in Turkey (Sesli & Denchev 2008). *Mycena pearsoniana* can be diagnosed by its 35–65 × 7–13 µm cylindrical cheilocystidia and pale blue to purplish pink pileus.

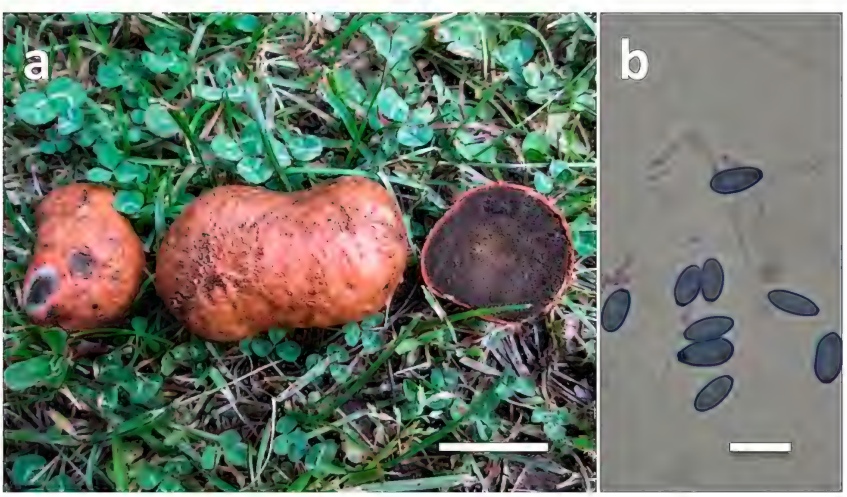

Fig. 3. *Rhizopogon rocabrunae*: a. basidiomata; b. basidiospores. Scale bars: a = 20 mm; b = 10 µm.

Rhizopogon rocabrunae M.P. Martín, Edic. Espec. Soc. Catalana Micol. 5: 95 (1996) Fig. 3 (a,b & c,d)

Fruit body 2–5 cm across, irregularly potato-shaped, ovate to globose, brown with reddish orange squamulose peridium, roughly sub-spherical, covered with brownish mycelial threads. The fruit body can be fully

Fig. 3. *Rhizopogon rocabrunae*: c. elements of pileipellis; d. basidia and glebal element. Scale bars: c = 20 µm; d = 10 µm.

embedded in the soil or somewhat extending upwards. Gleba olivaceous at maturity, quite solid and durable. Taste and smell not distinctive. Basidia 13–15 × 5–9 µm, clavate to cylindric, 4–spored, with basal clamp connection. Basidiospores 6.5–9(–10) × 2.5–3.5 µm, truncate, smooth, elongate, and some have two oil droplets.

Specimen examined: **TURKEY, Tokat,** Canpolat village, 40°33′55″N 36°36′48″E, 1245 m, solitary or gregarious a layer of *Abies alba* needles, 6 November 2013, leg. I. Türkekul (FGOU 4115).

Comments—*Rhizopogon rocabrunae* is an ectomycorrhizal species primarily associated with *Abies alba.* Its most remarkable features are a reddish orange squamulose peridium and elongated basidiospores clearly truncated at the base.

Stictis radiata (L.) Pers., Observ. Mycol. 2: 73 (1800) Fig. 4

Apothecia 4–8 mm, irregularly rounded, hymenium entirely embedded in the wood, yolk-yellow to bright orange-red, margin whitish, erect, short, and irregular, bulging upward and splitting into lobes. Hymenium variably pale orange to yellow or white. The base of the hymenium turns blue in iodine. Asci 150–220(–250) × 8–10 µm, cylindric. Ascospores 140–210 × 2–2.5 µm, smooth, filiform, hyaline. Paraphyses 150–190 × 1.5–2 µm, fibrous, numerous and very slender, and sometimes branched at the top.

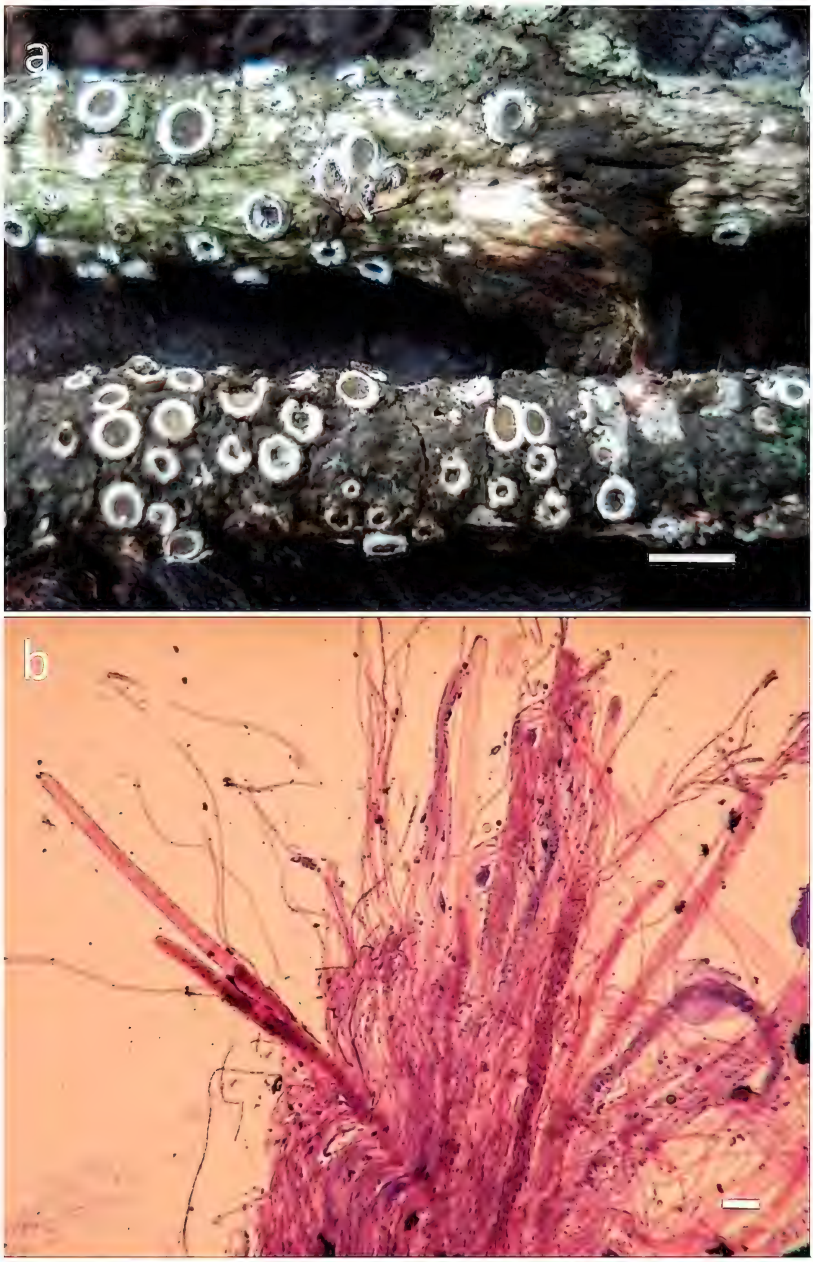

Fig. 4. *Stictis radiata*: a. apothecia; b. asci and paraphyses.
Scale bars: a = 10 mm; b = 20 µm.

Specimen examined: **TURKEY, Samsun,** Ladik village, 41°05′17″N 36°05′17″E, 734 m, on the decaying branches of deciduous trees, 9 September 2015, leg. I. Türkekul (FGOU 4974).

Comments—*Stictis radiata* is a new genus for Turkey (Sesli & Denchev 2008). Breitenbach & Kränzlin (1984) stated that it was found on many substrates, wood, herbaceous stems, fern rachises, and including decaying leaves. We collected our samples from decaying branches of deciduous trees. Macroscopically, it is very similar to *S. stellata,* which can be distinguished by a hymenium that does not turn blue in iodine.

Symphyosirinia angelicae E.A. Ellis,
Trans. Norfolk Norw. Nat. Soc. 18(3): 11 (1956) Fig. 5

Apothecia 6–10 mm diam., stalked, pale, light cream turning gray when dried. Hymenium pale ocher white, light cream, smooth, slightly concave. Stipe 18–25 × 0.2–0.4 mm, tubular, tapered at the top. Asci 80–110(–120) × 8–10 (–12) µm, cylindric, inoperculate, with an arched apex becoming sub-truncate when mature. Ascospores 14–17 × 5–6 µm, asymmetrically fusi-lageniform, slipper formed with one end pointed and the other rounded. Paraphyses 45–120 × 3–4 µm, cylindrical, smooth.

Specimen examined: **TURKEY, Samsun,** Ladik village, 40°57′07″N 35°53′36″E, 1020 m, on an infected *Heracleum* seed buried under litter or soil, 24 September 2015, leg. I. Türkekul (FGOU 4992).

Comments—*Symphyosirinia angelicae* is a mycorrhizal species found primarily on *Heracleum* seeds (Garcia & Moreau 2002). The stipe length varies according to the depth of the host seed under the soil.

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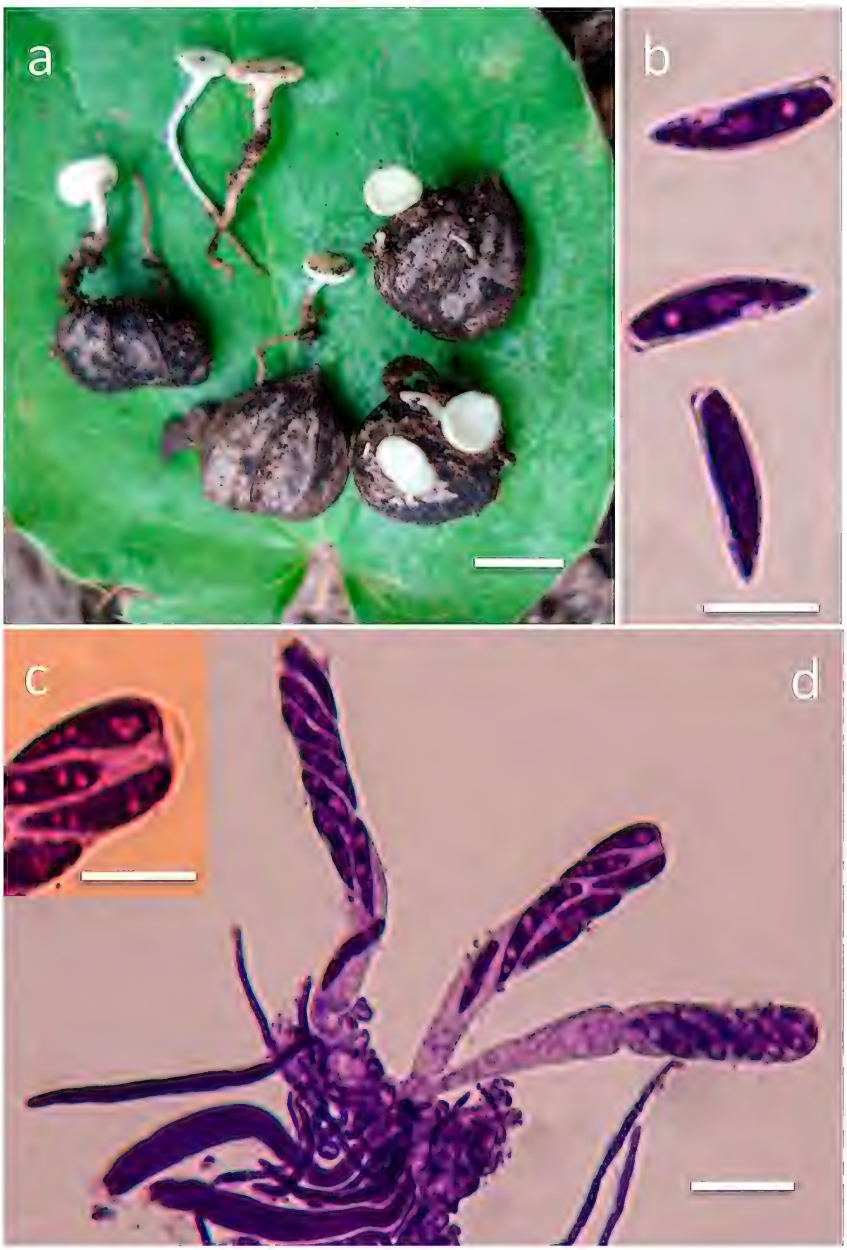

Fig. 5. *Symphyosirinia angelicae:* a. apothecia; b. ascospores;
c. amyloid apex of asci; d. asci and paraphyses. Scale bars: a = 10 mm; b, c = 10 µm; d = 20 µm.

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Tripospermum sinense sp. nov. from China

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Abstract—*Tripospermum sinense*, a new species isolated from submerged dicotyledonous leaves, is described and illustrated. It is characterized by solitary hyaline branched conidia composed of a short main axis and four asymmetrical lateral branches and by conidiogenous cells cicatrized after the conidia have detached.

Key words — aquatic hyphomycetes, morphology, taxonomy

Introduction

Tripospermum Speg. was established with *T. acerinum* (P. Syd.) Speg. as its type (Spegazinni 1918). The genus is characterized by the production of acrogenous or pleurogenous, hyaline to melanocratic, multiseptate, branched conidia often comprising a short main axis with 2–4 straight lateral branches (Ellis 1971). Twenty-seven species have been included in *Tripospermum* (Rocha et al. 2010; Index Fungorum 2016). *Tripospermum chiayiense* Matsush. and *T. variabile* Matsush. were originally described from Taiwan (Matsushima 1980, 1983), but there have been no reports of *Tripospermum* from mainland China.

Several new fungal taxa occurring on decaying leaves or branches in China have been described recently (Bai et al. 2013; Guo et al. 2015; Li et al. 2014; Ma et al. 2011a,b; Ren et al. 2012; Yang et al. 2011, 2012; Zhang et al. 2009). During a study of the aquatic hyphomycetes on submerged dicotyledonous leaves collected in Leigong Mountain, Guizhou Province, China (a Nature

[§]These authors contributed these work equally.

Reserve and National Forest Park), we encountered a fungus sharing features of *Tripospermum;* we describe this here as a new species, *T. sinense.*

Materials & methods

Submerged dicotyledonous leaves were collected from a stream in Leigong Mountain, Guizhou Province, China. Samples were preserved in zip-locked plastic bags for transport to the laboratory where the rotten leaves were cut into 2–4 × 2–4 cm fragments, spread onto the surface of CMA medium (20 g cornmeal, 18 g agar, 40 mg streptomycin, 30 mg ampicillin, 1000 ml distilled water), and incubated for about 10 days in Petri dishes. Single conidia were isolated for cultivation on CMA with the aid of a BX51 microscope and sterilized needles and the cultures were morphologically examined after incubation on CMA at 28°C for one week. A frozen culture is deposited in the Herbarium of the Laboratory for Conservation and Utilization of Bio resources, Yunnan University, Kunming, Yunnan, P.R. China (YMF, formerly Key Laboratory of Industrial Microbiology and Fermentation Technology of Yunnan).

Taxonomy

Tripospermum sinense Ying Huang & Z.F. Yu, **sp. nov.** PLATE 1

MycoBank MB 815346

Differs from *Tripospermum camelopardus* by its five-radiate conidia, from *T. myrti* by its larger conidia, and from *T. porosporiferum* by its smaller conidia.

TYPE: PR China, Guizhou Province, Leigong Mountain Nature Reserve and National Forest Park, 25°53″N 108°24″E, elev. 2178 m, on submerged leaves of an unidentified dicotyledonous plant in a stream, Oct. 2013, Z.F. Yu (**Holotype**, YMF 1.04181 [frozen culture]).

ETYMOLOGY: *sinense* refers to the country in which this species was found.

COLONIES growing on CMA, reaching about 20 mm diameter after 10 days at 25°C. Colony effuse, brownish to dark brown, mycelium scanty superficial, mostly in substratum immersed, composed of branched, septate, hyaline to brown-tinged hyphae. Vegetative hyphae hyaline to fuliginous, (2–)3–4(–6) µm wide. CONIDIOGENOUS CELLS monoblastic, intercalary, determinate, slightly denticulate or thickened, scarred, hyaline. Conidial secession schizolytic. CONIDIA, solitary, hyaline, branched; mature conidia comprise a short main axis [(15–)16–20(–32) × 4–5 µm, (0–)1–2(–3)-septate] and (almost always) four straight branches [(10–)14–38(–42) × 3–5 µm, (1–)2(–6)-septate]; three of the branches are produced from the terminal cell of the main axis (a lateral branch, a distal branch, and a sharply reflexed branch that runs parallel to the main axis); the fourth branch is lateral and produced from the proximal cell of the reflexed branch; occasional conidia have either more or fewer than 4 branches.

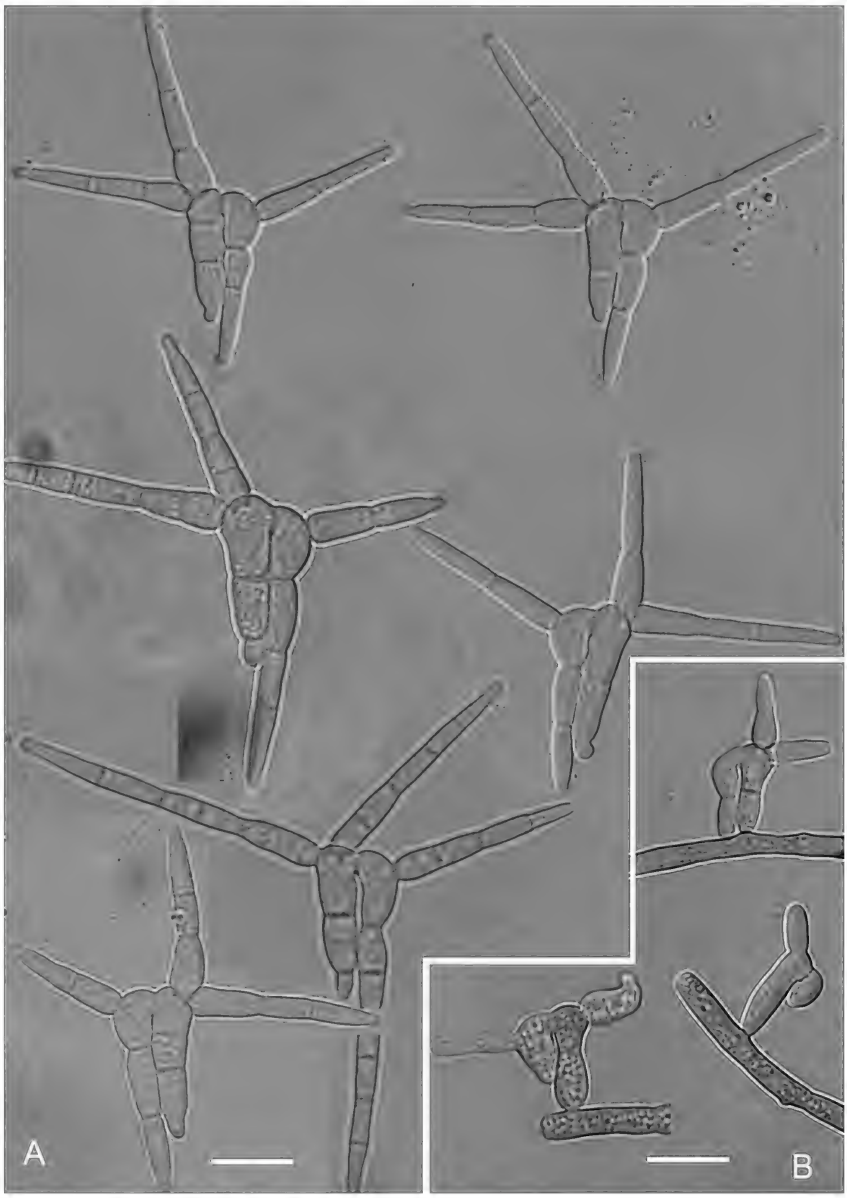

Plate 1. *Tripospermum sinense* (holotype, YMF 1.04181).
A. Conidia; B. Conidiogenous cells and conidia.
Scale bars = 10 μm.

Discussion

Tripospermum sinense fits well within the genus based on its conidiogenous cells, developmental process, branching pattern, and conidial shape. It resembles three species: *T. camelopardus* Ingold et al., *T. myrti* (Lind) S. Hughes, and *T. porosporiferum* Matsush. *Tripospermum camelopardus* is distinguished by conidia that generally have three lateral branches, with only one lateral branch attached to its main axis (Ingold et al. 1968). Like *T. sinense*, *T. myrti* produces 5-radiate conidia but differs by its smaller conidia [main axis 5–12 × 2.7 μm; parallel branches 13–30 × 4–5 μm with the other branches ≤35 μm long] and phialidic conidiogenous cells (Hughes 1951, Ingold & Cox 1957, Rocha et al. 2010). *Tripospermum porosporiferum* produces similarly shaped conidia, but its conidia are larger (Matsushima 1993), and its hyphae are about twice as wide as those of *T. sinense* (Rocha et al. 2010).

Tripospermum is morphologically similar to *Retiarius* D.L. Olivier. The mature conidia of the type species, *R. superficiaris* D.L. Olivier, resemble those of *T. sinense*, but conidia development substantially differs in *R. superficiaris:* the conidia branch dichotomously in early stages of development, then one of the two lobes branches dichotomously to produce a downwardly directed branch and a radially directed branch (Olivier 1978). In *T. sinense*, the conidial main axis produces thee branches from its distal cell, one of which is sharply reflexed to run parallel to the main axis, and a fourth branch is produced from the proximal cell of the reflexed branch.

Also, *Tripospermum sinense* (growing on dead submerged leaves) has a very different habitat from the two described *Retiarius* species (parasitic on pollen grains on the phylloplane of aerial living leaves; Olivier 1978). Therefore our new species has affinities with *Tripospermum*, rather than *Retiarius*.

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Calceispora hachijoensis and *Paratomenticola lanceolata*, newly recorded from China

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Abstract—*Calceispora hachijoensis* and *Paratomenticola lanceolata* are described and illustrated, based on Chinese collections on decaying twigs of unidentified broadleaf plants. These species are new records for China.

Key words—anamorphic fungi, taxonomy

Introduction

Several studies on conidial fungi developed in southern China have revealed a high number of novel taxa and new records (e.g., Guo et al. 2015; Ma 2016; Ma et al. 2016; Xia et al. 2015a,b, 2016a,b). During a mycological survey of conidial fungi occurring on decaying plant material from Henan and Guangxi provinces, China, specimens of *Calceispora hachijoensis* and *Paratomenticola lanceolata* were collected on decaying twigs. The specimens are described and illustrated below and are deposited in the Herbarium of Mycology, Jilin Agricultural University, Changchun, China (HMJAU).

Calceispora hachijoensis Matsush., Icon. Microfung. Matsush. Lect.: 20. 1975. Fig. 1

Conidiophores distinct, solitary, unbranched, cylindrical, 110–320 × 5–7 µm, ≤12-septate, brown to dark brown, paler toward the apex. Conidiogenous cells monophialidic, terminal, integrated, cylindrical, slightly swollen toward the belly, ≤6.5 µm diam., producing conidia by percurrent non-progressive proliferation from a single fertile locus at the apex where there is a prominent,

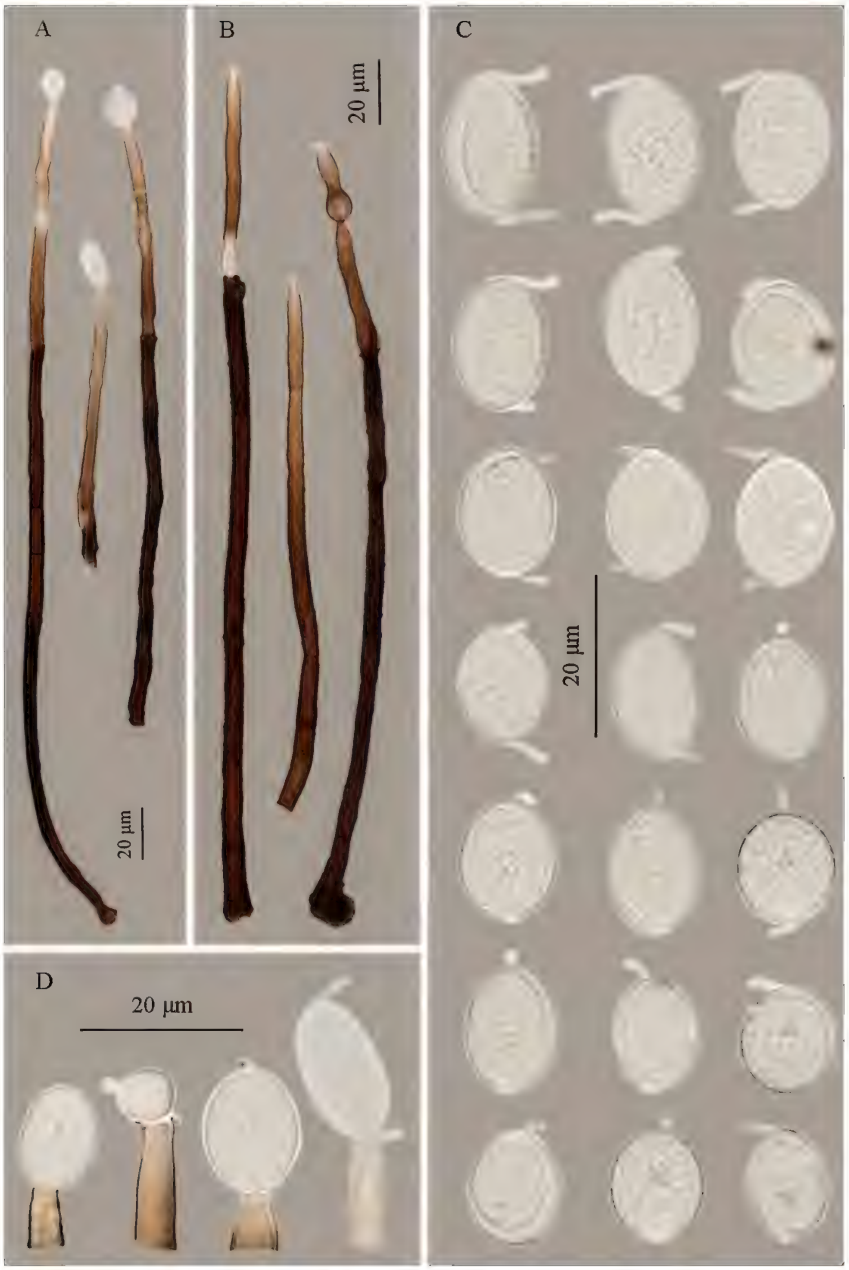

Fig. 1. *Calceispora hachijoensis* (HMJAU H7859). A. Conidiophores, conidiogenous cells, and conidia; B. Conidiophores and conidiogenous cells; C. Conidia; D. Conidiogenous cells and conidia.

slightly narrower collarette, 3.5–4.5 µm wide. Conidia colourless, subglobose to oval, thick-walled, aseptate, 13.5–18.5 × 10.5–12 µm, with a single, unbranched appendage at each end.

Specimen examined: **CHINA, Guangxi Province**, Longhu Mountain, on decaying twigs of an unidentified broadleaf tree, 10 Dec. 2015, C.L. Yang (HMJAU H7859).

Comments—*Calceispora* Matsush. was erected with *C. hachijoensis* as type species (Matsushima 1975) and remained monotypic until Sutton (1993) described *C. subglobosa* B. Sutton. *Calceispora* is characterized by monophialidic conidiogenous cells that produce hyaline aseptate conidia with unbranched cellular appendages. Our specimen fits well with the original description of *C. hachijoensis* (Matsushima 1975). This is the first report of this species in China.

Paratomenticola lanceolata (Cooke) M.B. Ellis,
More Demat. Hyphomyc.: 175. 1976. Fig. 2

Conidiophores macronematous, mononematous, erect, usually fasciculate (occasionally single), flexuous, smooth, septate, brown to dark reddish brown, sometimes paler toward the base, 70–110 × 8–10 µm. Conidiogenous cells polyblastic, sympodial, integrated, terminal becoming intercalary, cylindrical, denticulate, brown to dark reddish brown, 15–20 × 7–9 µm, conicotruncate at the apex. Conidia solitary, obclavate, straight or slightly flexuous, pale brown to brown, paler toward the apex, 7–13-distoseptate, 50–95 × 7.5–10.5 µm, tapering gradually to 2.5–4 µm diam. near the apex, with a dark brown to black, 2.5–3.5 µm wide scar at the base.

Specimen examined: **CHINA, Henan Province**, Jingangtai National Forest Park, on decaying twigs of an unidentified broadleaf tree, 4 Nov. 2015, C.L. Yang (HMJAU H7844).

Comments—*Paratomenticola* M.B. Ellis was erected with *Helminthosporium lanceolatum* Cooke [≡ *Paratomenticola lanceolata*] as type species (Ellis 1976), and remained monotypic until J.L. Crane & Schokn. (1982) described *P. georgiana*. Our specimen is similar to previous descriptions of the type specimen of *P. lanceolata*, except that the type had fewer (5–9) conidial septa (Cooke 1883, as "*H. lanceolatum*"; Ellis 1976). *Paratomenticola lanceolata* is reported for the first time from China.

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Fig. 2. *Paratomenticola lanceolata* (HMJAU H7844). A. Conidiophores, conidiogenous cells, and conidia; B. Conidiophores and conidiogenous cells; C. Conidia.

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Records of *Beltrania rhombica* and *Didymobotryum rigidum* from China

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Abstract—*Beltrania rhombica* and *Didymobotryum rigidum* are described and illustrated, based on Chinese collections on decaying twigs of unidentified broadleaf plants. *Beltrania rhombica* represents a new record for mainland China, and *D. rigidum* a new record for Guangdong Province.

Key words—anamorphic fungi, taxonomy

Introduction

Beltrania Penz. is typified by *B. rhombica*, which was described from *Citrus limonum* [= *Citrus limon*] in Italy (Penzig 1882). This genus was described with distinguishing characters such as setae with radially lobed basal cells, conidiophores with separating cells, and biconic conidia with a hyaline transverse band and apical tubular appendage. *Didymobotryum* Sacc., which was established with *Periconia rigida* Berk. & Broome [≡ *D. rigidum*] as the type species, was mainly characterized by synnematous conidiophores and monotretic conidiogenous cells that produce unbranched acropetal chains of 1-septate conidia (Saccardo 1886).

Tropical and subtropical forest ecosystems offer particularly suitable habitats for saprobic microfungi, among which the anamorphic are the most abundant and diverse (e.g., Ma 2016; Ma et al. 2016; Xia et al. 2015a,b, 2016a,b). During a mycological survey of conidial fungi occurring on decaying plant material from Henan and Guangdong provinces, China, specimens of *Beltrania rhombica* and

Didymobotryum rigidum were collected on decaying twigs. The specimens are described and illustrated below and are deposited in the Herbarium of Mycology, Jilin Agricultural University, Changchun, China (HMJAU).

Beltrania rhombica Penz., Michelia 2(8): 474. 1882. Fig. 1

Conidiophores macronematous, mononematous, arising in groups from the terminal cells of the immersed mycelium, erect, ascending, straight or

Fig. 1. *Beltrania rhombica* (HMJAU H6692). Conidiophores, conidiogenous cells, and conidia.

flexuous, unbranched, thick-walled, 4–8-septate, pale brown to mid brown, geniculate, conidial scars visible after secession of the conidia, 90–170 × 3–5 µm. Conidiogenous cells polyblastic, integrated, terminal, becoming lateral, determinate, cylindrical. Conidia solitary, dry, acrogenous or acropleurogenus, simple, biconic, smooth, slightly truncate at the base, with a rostrum at the apex, subhyaline to pale brown, with a hyaline median pale transverse band, 22–28 × 7.5–10 µm (rostrum exclude), rostrum 4.5–7 µm long.

Specimen examined: **CHINA, Henan Province**, Jigong Mountain, on decaying twigs of an unidentified broadleaf tree, 2 Nov. 2016, J.W. Xia (HMJAU H6692).

Comments—*Beltrania rhombica* is easily recognizable by its biconic conidia with a rostrum. Our specimen fits well with the original description of *B. rhombica* by Penzig (1882) except for the lack of setae. This species is reported for the first time from mainland China.

Didymobotryum rigidum (Berk. & Broome) Sacc., Syll. Fung. 4: 627. 1886. Fig. 2

Conidiomata synnematal, unbranched, erect, with brown to dark brown stalks, consisting of compact aggregation of parallel conidiophores, terminating in brown fertile heads, ≤1000 µm long and 35–45 µm diam. in the middle, ≤110 µm diam. at the base, and 260 µm diam. at the apex. Conidiophores macronematous, erect, unbranched, septate, pale brown to brown, 2–4 µm diam. Conidiogenous cells monotretic, integrated, terminal, thick-walled, smooth, brown. Conidial secession schizolytic. Conidia solitary, dry, ellipsoidal, 1-euseptate, smooth, brown, 11–12.5 × 4.5–6 µm; septa 1.5–2.5 µm thick, darkly pigmented.

Specimen examined: **CHINA, Guangdong Province**, Baiyun Mountain, on decaying twigs of an unidentified broadleaf tree, 6 Jun. 2015, J.W. Xia (HMJAU H6383).

Comments—*Didymobotryum rigidum* is easily recognizable by its synnematous conidiophores and monotretic conidiogenous cells that produce catenate ellipsoidal conidia. This species has previously been reported from Sri Lanka, Thailand, Vietnam, China (Hong Kong), Japan, and Cuba (Berkeley & Broome 1873; Ellis 1971; Jones et al. 2004; Kobayashi 2007; Lu et al. 2000; Mercado Sierra et al. 1997; Minter et al. 2001; Saccardo 1886; Zhuang 2001); it is reported here for the first time from Guangdong Province.

Acknowledgments

The authors express gratitude to Dr. Xiu-Guo Zhang and Dr. Jian Ma for serving as pre-submission reviewers and for their valuable comments and suggestions. This project was supported by the National Natural Science Foundation of China (30600003). We acknowledge the facilities provided by Dr. P.M. Kirk and Drs. V. Robert, G. Stegehuis

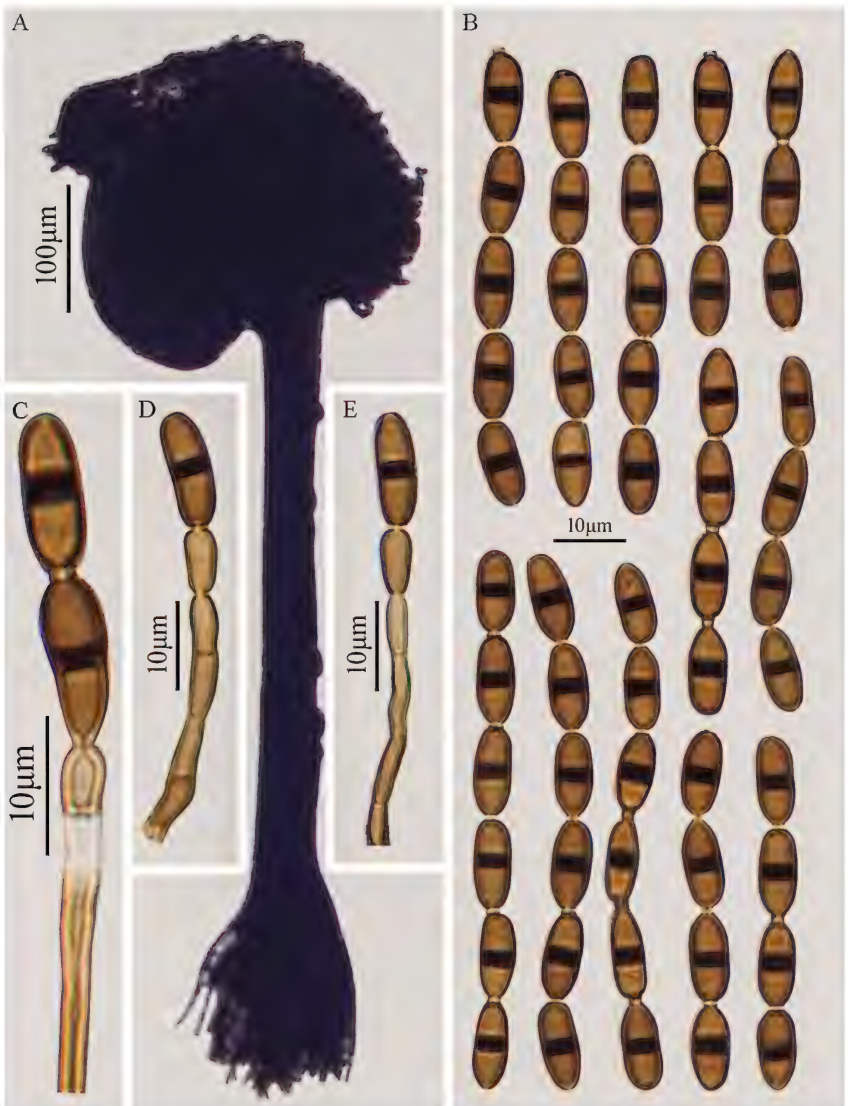

Fig. 2. *Didymobotryum rigidum* (HMJAU H6383).
A. Synnema; B. Conidia; C–E. Conidiophores, conidiogenous cells, and conidia.

and Arthur Decock through the Index Fungorum and MycoBank websites. Dr. Lorelei Norvell's editorial review and Dr. Shaun Pennycook's nomenclature review are greatly appreciated.

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New records of *Lepraria* and *Trapelia* from China

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Abstract—As a result of our study on the lichen flora of Guizhou Province in China, *Lepraria caesiella*, *L. pallida* and *Trapelia placodioides* are reported for the first time from China, and *Lepraria. cupressicola* is reported for the first time from Guizhou Province.

Key words—taxonomy, lichenized fungi, Asia

Introduction

Guizhou Province lies in the Yungui Plateau, located in the southwestern part of China. The climate is warm and moist with an annual temperature ranging from 14 to 16 °C. Terrain in this hilly province has an average elevation of 1100 m. Annual precipitation averages 1200 mm and mostly occurs during the summer (June–September). There is little information available regarding the current occurrence of lichens in Guizhou. The purpose of this paper is to provide new distributional information for lichen taxa in Jiangkou, Dejiang, and Leishan counties in Guizhou Province.

Lepraria Ach. was described for sterile lichens. Laundon (1989, 1992) revised the concept of *Lepraria* to comprise lichen-forming fungi with leprose thalli that never develop fruiting bodies. More recently Lendemer & Hodkinson (2013) revised *Lepraria*, using molecular phylogenetic analyses and morphology. Although the modern circumscription of *Lepraria* essentially follows that of Laundon (1989, 1992) morphologically, it now also

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includes several sterile fruticose species historically placed in *Leprocaulon* Nyl (Lendemer & Hodkinson 2013). Similarly, some species with unusual chemistries such as argopsin, pannarin, and usnic acid that were originally placed in *Lepraria* were shown to belong to other lineages in the *Ascomycetes* (Lendemer & Hodkinson 2013). Importantly Lendemer (2011) also introduced a standardized morphological terminology and descriptive scheme that should facilitate specimen identification and description preparation.

In this study, *Lepraria caesiella*, *L. pallida,* and *Trapelia placodioides* are reported for the first time from China, and *Lepraria cupressicola* is reported for the first time from Guizhou Province.

Materials & methods

The specimens were collected in Guizhou Province, China, and are preserved in Lichen Section of the Botanical Herbarium, Shandong Normal University, Jinan, China (SDNU). The specimens were examined morphologically under a COIC XTL7045B2 stereo-microscope and an Olympus CX41 polarizing microscope. Thallus and medulla were identified by testing with K (a 10% aqueous solution of potassium hydroxide), C (a saturated solution of aqueous sodium hypochlorite), and P (a saturated solution of *p*-phenylenediamine in 95% ethyl alcohol). The lichen substances were identified using standardized thin layer chromatography techniques (TLC) with system C (Orange et al. 2001). The lichens were photographed using Olympus SZX16 and BX61 with DP72.

Taxonomy

Lepraria caesiella R. C. Harris, Opusc. Philolich 2: 51 (2005) Fig. 1a

Morphology—Thallus crustose, leprose, aggregated, discontinuous and not stratified, whitish green to pale bluish grey, initially consisting of isolated granules, eventually merging to form a thin crust (<0.1 mm thick); hyphae hyaline, 25–30 μm long, septate secund, obscured by a thick layer of crystals that dissolve in KOH and recrystallize as thin bent needles, with a few surrounding the granules and anchoring the granules to each other tightly; prothallus absent; hypothallus absent; rhizohyphae absent. Granules globose, ecorticate, (20–)50(–70) μm diam., well organized and discrete, remaining distinct and not forming compound units. Photobiont green, coccoid, cells globose, 7.5–12.5μm diam. Substrate acid rock in sheltered microhabitats.

Chemistry—Cortex and medulla K+ yellow, C+ yellow, KC+ yellow. Atranorin and zeorin detected by TLC.

Distribution—North and South America, Greenland, South Korea, Canada, Low Arctic (Saag et al. 2007, 2009; Joshi et al. 2010; Lendemer 2012, 2013a). New to China.

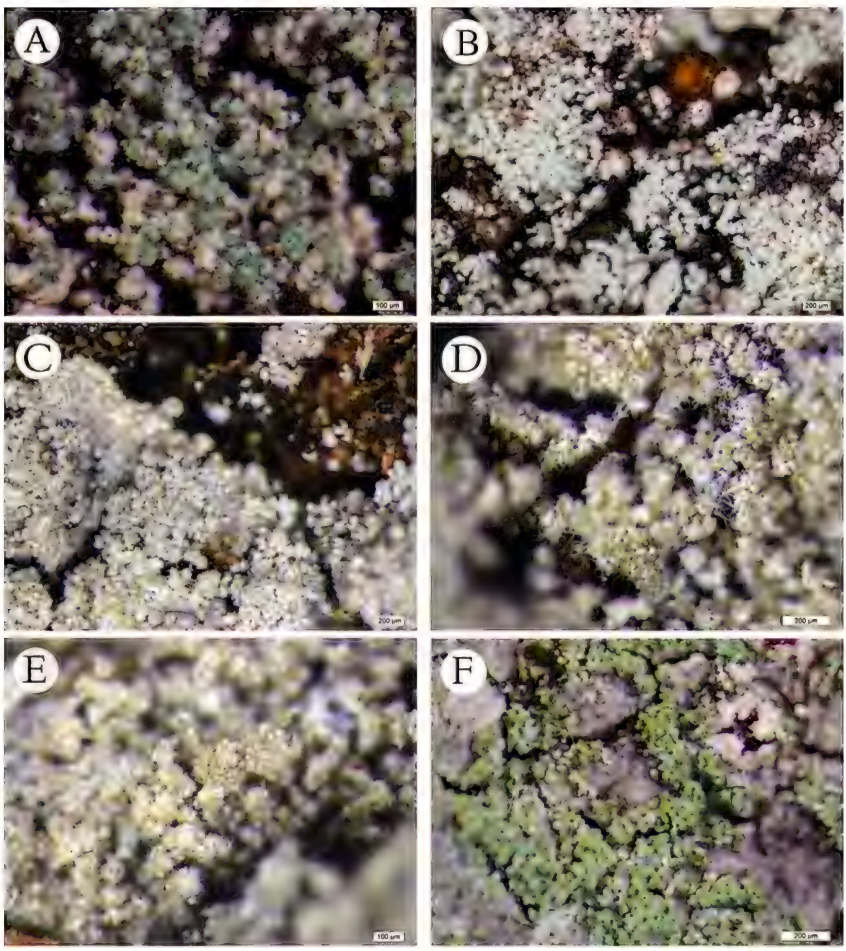

Fig. 1. A, *Lepraria caesiella*; B. *Lepraria cupressicola*; C. *Lepraria pallida,* D, E. Granules of *L. pallida*; F. *Trapelia placodioides*. Scale bars: A, E = 100 μm; B–D, F = 200 μm.

Specimen examined: **China**. **Guizhou**, Jiangkou, Jiangxicun, 27°32′31″N 108°34′59″E, alt. 695m, on rock, 3 Apr. 2016, X.X. Zhao 20160898 (SDNU).

Comments—*Lepraria caesiella* is chemically similar to *L. harrisiana* Lendemer, which is morphologically distinguished by a *cryophila*-type placodioid thallus (Lendemer 2013a). *Lepraria elobata* Tønsberg and *L. neglecta* (Nyl.) Erichsen also share morphological similarities, but *L. elobata* produces salazinic acid or stictic acid in addition to atranorin and zeorin while *L. neglecta* produces

stictic acid in the zeorin-producing chemotypes (Lendemer 2013b). *Lecanora nothocaesiella* Lendemer & R.C. Harris, a sorediate member of the *Lecanora subfusca* group with *allophana*-type apothecia, differs from *L. caesiella* in not producing a truly leprose thallus (Lendemer 2011).

Lepraria cupressicola (Hue) J.R. Laundon, Lichenologist 40: 412 (2008) FIG. 1B

= *Lepraria atrotomentosa* Orange & Wolseley, Biblioth. Lichenol. 78: 328 (2001)

MORPHOLOGY—Thallus crustose, leprose, placodioid, continuous thalli or sometimes diffuse, pale whitish grey to greenish grey, consisting of loosely to densely packed granules with a softened margin; hyphae hyaline, 20–40 µm long, few to abundant surrounding the granules, anchoring the granules tightly to one another and loosely to the substrate; prothallus absent; hypothallus present, usually forming a thin continuous layer underneath the granules and extending outward from the edge of the thallus; rhizohyphae present, pale to black. Granules globose, aggregated, 100–120 µm diam., abundant. Photobiont green, ±spherical, 7.5–15 µm diam. Substrate bark.

CHEMISTRY—Cortex and medulla K+ yellow, C+ red, KC–, Pd+ pale yellow. Atranorin, zeorin, lecanoric acid (minor), roccelic/angardianic acid (minor) detected by TLC.

DISTRIBUTION—Australia, China (Hong Kong, Taiwan), Sri Lanka, Japan (Saag et al. 2009, McCarthy & Kuchlmayr 2009). New to Guizhou Province.

SPECIMEN EXAMINED: **CHINA. GUIZHOU**, Dejiang, Jingangling, 28°10′15″N 107°51′39″E, alt. 1100m, on bark, 26 May. 2016, X.X. Zhao & W.C. Wang 20160867 (SDNU).

COMMENTS—*Lepraria impossibilis* Sipman and *L. pallida* are morphologically similar to *L. cupressicola*, but do not produce lecanoric acid (Saag et al. 2009). We accept the synonymy of *L. atrotomentosa* under *L. cupressicola* (Laundon 2008, Saag et al. 2009).

Lepraria pallida Sipman, Herzogia 17: 31 (2004) FIG. 1C–E

MORPHOLOGY—Thallus crustose, leprose, placodioid, continuous thalli with rather thin layer, cream white to pale grey, consisting of densely packed granules with a softened and delimited margin; hyphae hyaline, 20–40(–60) µm long, none surrounding the granules, anchoring the granules to each other tightly; prothallus absent; hypothallus present, usually forming a thin continuous layer underneath the granules and extending outward from the edge of the thallus; rhizohyphae absent. Granules ± globose, usually inserted into the hypothallus, 120–300 µm diam., abundant. Photobiont green, spherical or globose, 8–10 µm in diam. Substrate bark.

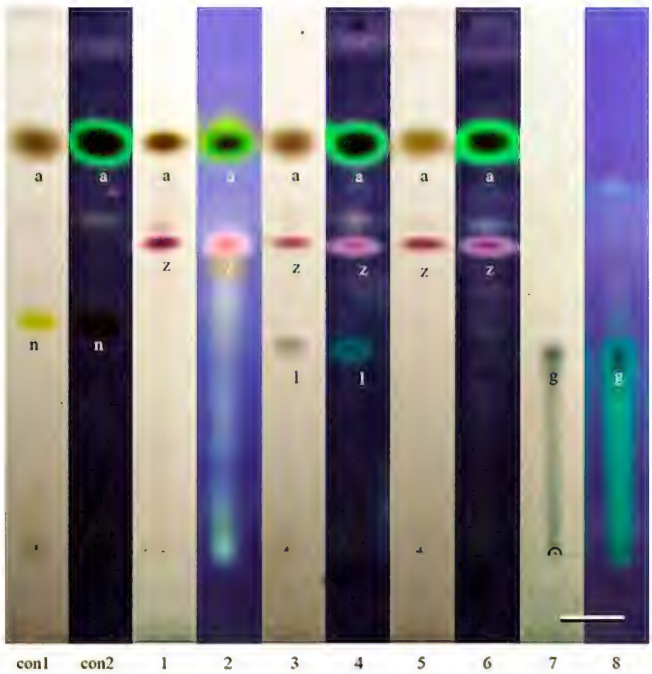

FIG. 2. TLC chromatograms (in solvent C): con1, con2. *Lethariella cladonioides*; 1, 2. *Lepraria caesiella*; 3, 4. *Lepraria cupressicola*; 5, 6. *Lepraria pallida*; 7, 8. *Trapelia placodioides*. Conditions of observation: con1, 1, 3, 5, 7; visible light, after heating; con2, 2, 4, 6, 8, UV365, after heating. Compounds detected: a = atranorin; g = gyrophoric acid; l = lecanoric acid; n = norstictic acid; z = zeorin. Scale bar = 10 mm.

CHEMISTRY—Cortex and medulla K+ yellow, C–, KC–, Pd+ yellow. Atranorin, zeorin, unidentified fatty acids (minor) detected by TLC.

DISTRIBUTION—South America, Africa, South Korea (Saag et al. 2009, Joshi et al. 2010). New to China.

SPECIMEN EXAMINED: **CHINA. GUIZHOU**, Kaili, Leishan, Leigongshan, alt. 2100m, on bark, 1 Apr. 2011, D.F. JIANG 20112243 (SDNU).

COMMENTS—*Lepraria pallida* is chemically similar to *L. lobata* Elix & Kalb, which differs by its greener colour and its gray to black hypothallus (Joshi et al. 2010).

Trapelia placodioides Coppins & P. James, Lichenologist 16: 257 (1984) FIG. 1F

MORPHOLOGY—Thallus crustose, closely appressed, cracked in the center, margin placodioid, areoles forming, with a rough surface, 0.2–0.5(–0.6) mm

diam., whitish to grey. Soralia numerous, 0.2–0.3 mm diam., usually developing from sides of areolae or from cracks in the thallus and then spreading more widely over large, flat thalli, pale greenish white or pale creamy; soredia 20–30 μm diam., farinose to somewhat granular. Apothecia 0.2–0.8 mm diam., rose-pink to red-brown, black when dry; thalline exciple thin, white, smooth to crenate, ± forming a halo-like rim, at least when young. Ascospores 15–25 × 7–13μm. Substrate rock.

Chemistry— Thallus and soralia C+ red, K–, KC–. Gyrophoric acid detected by TLC.

Distribution—Europe, North America and New Zealand (Coppins & James 1984, Foucard 1990, Nimis 1993, Kondratyuk et al. 1996, Brodo et al. 2001, Santesson et al. 2004, Sérusiaux et al. 2004, Purvis et al. 2009, Esslinger 2011, Galloway & Ledingham 2012). New to China.

Specimens examined: **CHINA. Guizhou**, Jiangkou, Xiaodingshan, 27°32′53″N 108°34′55″E, alt. 900m, on rock, 4 Apr. 2016, X.X. Zhao 20160212, 20160213 (SDNU).

Comments—*Trapelia placodioides* is characterized by its saxicolous habit, its whitish, spreading, areolate-cracked to continuous thallus, pale greenish white to whitish soralia developing at first from margins of areolae and thallus cracks but later becoming confluent, and gyrophoric acid (C+ red) in the medulla and soralia (Coppins & James 1984). It is morphologically similar to *T. coarctata* and *T. glebulosa*, which have the same apothecial characteristics and white thallus, but lack soralia (Purvis et al. 2009).

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Lecanora subloekoesii sp. nov. and four other species of the *L. subfusca* group new to China

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Abstract—A new species of *Lecanora* is described from China: *L. subloekoesii*, which is similar to *L. loekoesii* but differs by its 8-spored asci. Four species newly recorded from China are discussed: *L. chionocarpa*, *L. hybocarpa*, *L. praepostera*, and *L sulcata*. A detailed taxonomic description, ecological and chemical characters, and illustrations are provided for the new taxon, and brief comments and illustrations for the newly reported taxa.

Keywords—1-septate ascospore, *Ascomycota*, *Lecanorales*, *Lecanoraceae*, usnic acid

Introduction

Lecanora Ach., a cosmopolitan genus with over 552 species (Kirk et al. 2008), is one of the largest genera of lichenized ascomycetes. It is a heterogeneous assemblage of different groups, several of which probably deserve generic rank (Lumbsch & Elix 2004, Zhao et al. 2015). The *Lecanora subfusca* group, which is the core group that includes the type species, is characterized by the presence of oxalate crystals in the amphithecium and the production of atranorin and/or usnic acid in the cortex (LaGreca & Lumbsch 2001). The group has received considerable attention during the past few decades, which has resulted in numerous regional revisions and the description of numerous new species (Brodo 1984; Miyawaki 1988; Brodo et al. 1994; Guderley 1999; Guderley & Lumbsch 1999; Lumbsch & Elix 2004; Ryan et al. 2004; Nayaka 2005; Han et al. 2009; Knudsen & Lendemer 2009; Lü et al. 2011).

During study of *Lecanora* in China, an unreported species belonging to the *L. subfusca* group was discovered to represent a new species, proposed here as *Lecanora subloekoesii*. In addition, four other species belonging to this group, *L. chionocarpa*, *L. hybocarpa*, *L. praepostera*, and *L. sulcata*, are reported here as new records from China.

Materials & methods

The specimens studied are housed in the Lichen Section of the Botanical Herbarium, Shandong Normal University, Jinan, China (SDNU) and at the Korean Lichen Research Institute, Sunchon, Korea (KoLRI).

The specimens were examined morphologically under a COIC XTL 7045B2 stereomicroscope and photographed using an Olympus SZX16 dissecting microscope. The anatomical characters, such as apothecial tissues, crystal types, asci, ascospores and so on, were examined by hand-cut sections under an Olympus CX41 polarizing microscope and photographed using an Olympus BX61 with DP72. Lichen substances were identified using spot tests and standardized thin layer chromatography techniques (TLC) with solvent system C (Orange et al. 2010).

Taxonomy

Lecanora subloekoesii Z.T. Zhao & L. Lü, **sp. nov.** Pl. 1

MycoBank MB 812188

Differs from *Lecanora loekoesii* by its brown to reddish brown apothecial discs and its 8-spored asci.

Type: China. Heilongjiang Province, Wuchang, Mt. Datudingzi, 44°31′N 128°15′E, alt. 1200 m, on bark, 21/VIII/2011, Y.L. Cheng 20122275A (**Holotype**, SDNU).

Etymology: The epithet refers to the similar species, *L. loekoesii*.

Thallus crustose; surface dirty gray to yellowish gray, continuous to rimose-areolate, rough to verruculose, esorediate; margin indistinct; prothallus not visible. Apothecia lecanorine, sessile, 0.3–1.7 mm in diam; disc brown to reddish brown, epruinose, plane to convex; margin paler than thallus, thin to thick, prominent, entire to flexuous, smooth. Amphithecium with small crystals insoluble in K, 100–135 µm thick; cortex indistinct, basally not thickened, cortical granules dissolved in K; parathecium hyaline, with crystals soluble in K; epihymenium brown to reddish brown, pigment soluble in K, with coarse crystals soluble in K, 10–12.5 µm thick; hymenium hyaline, 55–60 µm thick; subhymenium hyaline to pale yellow, 25–35 µm thick; hypothecium indistinct; paraphyses simple, expanded in the tips, up to 1.5 µm wide; asci clavate, 8-spored; ascospores hyaline, simple (or appearing 1-septate due to divided protoplasm), ellipsoid, 10–15 × 4–7µm, wall <1 µm thick. Pycnidia not observed.

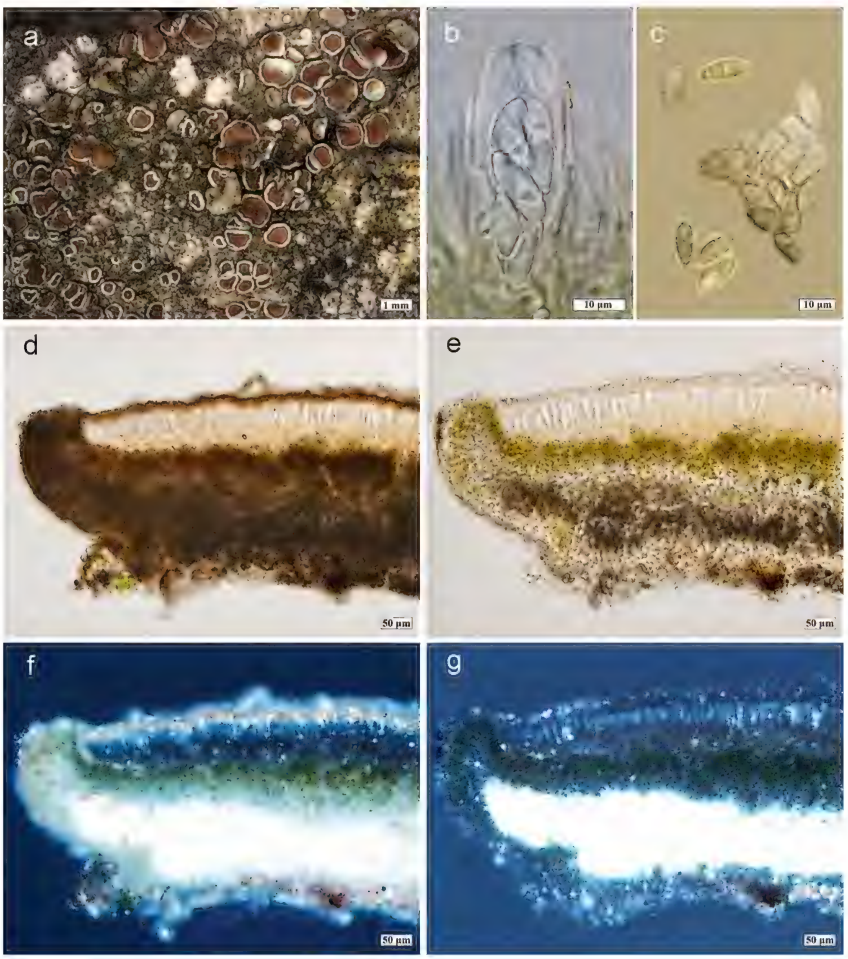

Plate 1. *Lecanora subloekoesii* (holotype, SDNU). a: Thallus. b: Ascus. c: Ascospores. d: Apothecium section. e: Pigment of epihymenium soluble in K. f: Crystals in apothecium section. g: Crystals of epihymenium soluble in K. Scale bars: a = 1 mm; b, c = 10 µm; d–g = 50 µm.

Chemistry: cortex: K+ yellow, C–, KC+ yellow, P–; medulla: K+ yellow, C+ yellow, KC+ yellow, P–; atranorin, usnic acid, zeorin, and traces of norstictic acid present.

Ecology and distribution: The new species was found on bark from mountainous regions of Anhui, Heilongjiang, Jilin, Liaoning, and Shanxi Provinces, at elevations of 900–2000 m.

Additional specimens Examined (all in SDNU, unless otherwise indicated):

Lecanora subloekoesii **CHINA. Anhui Province**, Liuan, Huoshan, Mt. Baimajian, alt. 1200 m, on bark, 8/ VI /2011, Y.L. Cheng 20113302A-1. **Jilin Province**, Wangqing, Dadoudiwa, alt. 900 m, on bark, 23/VII/2012, H.Y. Wang 20128212, 20128215, 20128216, 20128209; Mt. Tulaopodingzi, alt. 1100 m, 22/VII/2012, H.Y. Wang 20128201, 20128220, 20128223; Mt. Naitou, alt. 1100 m, 18/VIII/2011, Y.L. Cheng 20120112B. **Liaoning Province**, Kuandian, Mt. Huabo, alt. 800 m, on bark, 18/VIII/2011, D.F. Jiang 20120395D. **Shanxi Province**, Ningshan, Pingheliang, alt. 2060 m, on bark, 28/VII/2005, Y.J. Li & W. Fu L-928B.

Lecanora allophana (Ach.) Nyl.: **CHINA. Gansu Province,** Wenxian, Qiujiaba, alt. 2350 m, 3/VIII/2006, X.L. Shi 061572-2; alt. 2610 m, 4/VIII/2006, C.L. Wang 062133; Zhouqu, Huacaopo, alt. 3200 m, 29/VII/2006, Z.T. Zhao 060893. **Shaanxi Province**, Meixian, Mt. Taibaishan, alt. 1610 m, 1/VIII/2005, X.L. Shi QL582; alt. 1800 m, 2/VIII/2005, S.X. Guo QL275.

Lecanora imshaugii Brodo **CHINA. Anhui Province,** Liuan, Huoshan, Mt. Baimajian, alt. 1100 m, 9/VI/2011, Y.L. Cheng 20113257A; Y. Dong 20112999A; alt. 1400 m, 8/VI/2011, H.Y. Wang 20113364B. **Gansu Province,** Wenxian, Qiujiaba, alt. 2690 m, 4/VIII/2006, Z.F. Jia 062225.

Lecanora loekoesii L. Lü et al.: **CHINA. Heilongjiang Province**, Wuchang, Mt. Datudingzi, alt. 1800 m, 21/VIII/2011, Y.L. Cheng 20122274B; alt. 1300 m, 21/VIII/2011, Y.L. Cheng 20122316B. **SOUTH KOREA. Gangwon-do**, Taebaek-si, Mungoksodo-dong, Mt. Taebaek, 37°06′49″N 128°56′51″E, alt. 910 m, on *Quercus* bark, 13/X/2005, Lőkös 050717 (holotype, KoLRI).

Remarks: The new species is characterized by the amphithecium with small crystals, an epihymenium with coarse superficial granules, and the presence of usnic acid, zeorin, and norstictic acid besides atranorin. Another *Lecanora* with 1-septate ascospores is *L. loekoesii,* which has the same chemistry but differs in the yellowish brown apothecial discs and 12–16-spored asci. Both *L. subloekoesii* and *L. loekoesii* are distributed in mainly Northeast China, but they are allopatric and *L. loekoesii* has a wider elevation range (488–2900 m). *Lecanora subloekoesii* is morphologically similar to *L. allophana* and *L. imshaugii*, but both of them lack granules or crystals in the epihymenium. Moreover *L. allophana* contains only atranorin alone, while *L. imshaugii* contains atranorin and zeorin.

Lecanora chionocarpa Hue, Ann. Mycol. 5: 89. 1907. Pl. 2A

Chemistry: atranorin, zeorin; other unidentified substances also sometimes present.

Distribution: *L. chionocarpa* has been reported from Japan and Korea (Miyawaki 1988). New to China.

Specimens examined (all in SDNU):

Lecanora chionocarpa: **CHINA. Heilongjiang Province**, Tielishi, Taoshan national forest park, alt. 800 m, 23/VIII/2011, Y.L. Cheng 20125506, 20125333;

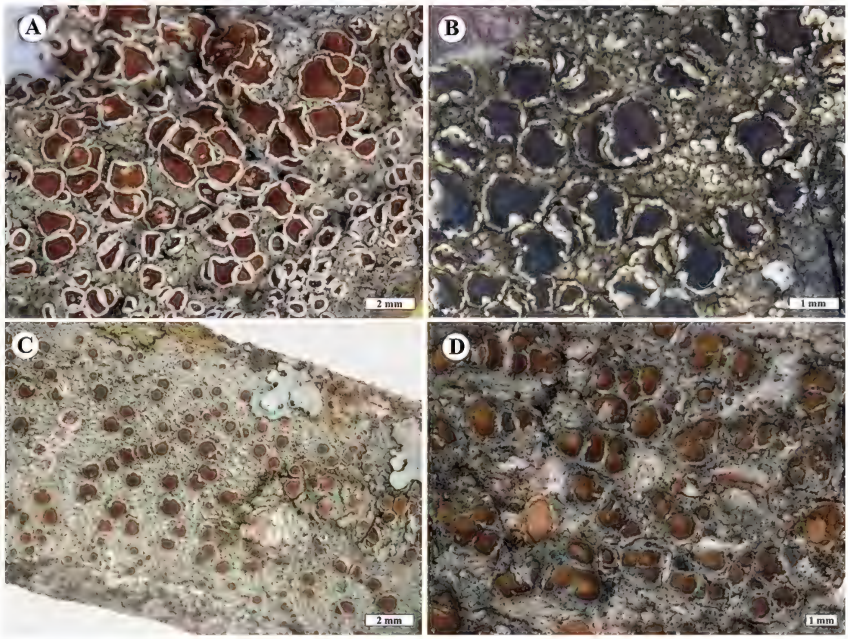

Plate 2. *Lecanora* species, new records in China.
A. *L. chionocarpa*. B. *L. hybocarpa*. C. *L. praepostera*. D. *L. sulcata*

Wuchang, Mt. Datudingzi, alt. 800 m, 21/VIII/2011, Y.L. Cheng 20122221, 20122247A, 20122247B; Tahe, Mengkeshanlinchang to Walaganzhen, alt. 555 m, 14/VIII/2009, Z.J. Ren 20102035. **Henan Province**, Nanyang, Neixiang, Mt. Baotianman, alt. 1600 m, 14/VI/2011, H.Y. Wang 20113298; Y. Dong 20113837; alt. 1700 m, 14/VI/2011, H.Y. Wang 20113669; Luanchuan, Mt. Laojun, alt. 1800 m, 12/VI/2011, H.Y. Wang 20113378. **Jilin Province**, Fushun, Mt. Changbai, alt. 640 m, 1989, Z.T. Zhao 9802402A, 9802402B, 9802402C; Wangqing, Dadoudigou, alt. 900 m, 23/VII/2012, H.Y. Wang 20128245, 20128258, 20128233; Changbaishanlvyouqu, Chibeiqu, Mt. Naitou, alt. 1100 m, 18/VIII/2011, Y.L. Cheng 20120060A, 20120100B, 20120100C; Helong, Mt. Zengfeng, alt. 1600 m, 19/VIII/2011, D.F. Jiang 20119398, 20119530. **Liaoning Province**, Kuandian, Mt. Huaboshan, alt. 900 m, 16/VIII/2011, Y.L. Cheng 20120458A, 20120553; alt. 950 m, 16/VIII/2011, D.F. Jiang 20120562. **Shandong Province**, Yantai, Mt. Kunyu, alt. 400 m, 17/XI/2010, Z.J. Ren 20127922.

Lecanora megalocheila (Hue) H. Miyaw.: **CHINA. Anhui Province**, Liuan, Huoshan, Mt. Baimajian, alt. 1100 m, 9/VI/2011, Z.L. Huang 20112944A; Y. Dong 20113221. **Heilongjiang Province**, Tielishi, Taoshan national forest park, alt. 800 m, 23/VIII/2011, Y.L. Cheng 20125691; Wuchang, Mt. Datudingzi, alt. 1100 m, 21/VIII/2011, Y.L. Cheng 20122379.

Remarks: The species is characterized by the cottony appearance of its thallus, white fibrous prothallus, non-granular epihymenium, and abundant

production of zeorin. *Lecanora allophana* and *L. megalocheila* are similar to *L. chionocarpa*, but *L. allophana* contains atranorin alone, and *L. megalocheila* has a granular epihymenium.

Lecanora hybocarpa (Tuck.) Brodo, Beih. Nova Hedwigia 79: 134. 1984. Pl. 2B

Chemistry: atranorin alone.

Distribution: *L. hybocarpa* has been reported from eastern North America (less common in the west) and western Europe (Ryan et al. 2004). New to China.

Specimens examined (all in SDNU):

Lecanora hybocarpa: **China. Gansu Province**, Zhouqu, Shatanlinchang, Renmingdigou, alt. 3100 m, 30/VII/2006, H.Y. Wang 061334. **Yunnan Province**, Luquanxian, Jiaozixueshan, alt. 3600 m, 4/XI/2012, H.Y. Wang 20129377.

Lecanora chlarotera Nyl.: **China. Fujian Province**, Wuyishanshi, Tongmusangang, alt. 1200 m, 24/X/2010, D.F. Jiang 20105660A, 20105660B. **Guizhou Province**, Libo, Maolanbaohuqu, alt. 350 m, 2/XI/2009, H.Y. Wang 20102328, 20102339.

Lecanora pulicaris (Pers.) Ach.: **China. Sichuan Province**, Litangxian, Mt. Kazila, alt. 4700 m, 7/XI/2008, Z.S. Sun 20080650; alt. 4700 m, 7/XI/2008, Y.D. Du 20080281. **Xizang Province**, Linzhidiqu, Lulangzhen, Mt. Sejila, alt. 4200 m, 27/XI/2007, G.Y. Han 20073298. **Yunnan Province**, Lijiangshi, Mt. Laojun, alt. 3800 m, 5/XI/2009, H.Y. Wang 20100257.

Remarks: The species is characterized by pale to dark orange-brown apothecial discs, verruculose to verrucose apothecial margin, the epihymenium with fine granules, and a relatively uniformly thickened apothecial cortex. *Lecanora hybocarpa* is similar to *L. chlarotera* and *L. pulicaris*, but *L. chlarotera* contains gangaleoidin and has a coarsely granular epihymenium, and *L. pulicaris* usually contains fumarprotocetraric acid besides atranorin and has an expanded cortex at the apothecial base.

Lecanora praepostera Nyl., Flora 56: 19. 1873. Pl. 2C

Chemistry: atranorin and norstictic acid present.

Distribution: *Lecanora praepostera* has been reported from the U.K., France, Canary Islands. (Hawksworth & Dalby 1992). New to China.

Specimens examined (all in SDNU):

Lecanora praepostera: **China. Jilin Province**, Changbaishanlvyouqu, Chibeiqu, Mt. Naitou, alt. 1100 m, 18/VIII/2011, Y.L. Cheng 20120121B, 20120121C, 20119624; Helong, Mt. Zengfeng, alt. 1500 m, 19/VIII/2011, Y.L. Cheng 20119687, 20119807, 20119759. **Shaanxi Province**, Ningshan, Baiyangling, alt. 2075 m, 30/VII/2005, W. Fu 20127925.

Remarks: The species is characterized by the cracked-areolate thallus, an epihymenium with K+ red, coarse granules, and the presence of norstictic acid beside atranorin. *Lecanora praepostera* can be distinguished from most

other species of *Lecanora* in China by the K+ yellow to red thallus cortex and amphithecium producing small K+ red acicular crystals.

Lecanora sulcata (Hue) H. Miyaw., J. Hattori Bot. Lab. 64: 307. 1988. Pl. 2D

Chemistry: atranorin present.

Distribution: *L. sulcata* has been reported from Japan and Korea (Lü et al. 2011). New to China.

Specimens examined (all in SDNU):

Lecanora sulcata: **CHINA. Guizhou Province,** Kaili, Mt. Leigongshan, alt. 1800 m, 24/VIII/2010, D.F. Jiang 20103273A. **Shaanxi Province**, Ningshan, Pingheliang, alt. 2550 m, 3/VIII/2005, C.L. Wang TBW196.

Lecanora cinereofusca H. Magn.: **CHINA. Fujian Province,** Wuyishanshi, Tongmucun, Guidun, alt. 1200 m, 26/X/2010, D.F. Jiang 20105040; X.R. Kou 20105145. **Guizhou Province,** Kaili, Leigong, Mt. Leigong, alt. 1800 m, 24/VIII/2010, D.F. Jiang 20112149. **Jilin Province**, Helong, Mt. Zengfeng, alt. 1600 m, 19/VIII/2011, Y.L. Cheng 20119892.

Lecanora insignis Degel.: **CHINA. Fujian Province,** Wuyishanshi, Tongmusangang, alt. 1200 m, 25/X/2010, H.Y. Wang 20105471B, 20105092B, 20105091A. **Gansu Province,** Wudu, Pandixiang, Tielugou, alt. 1650 m, 07/VIII/2006, F. Yang 062497-1, 062497-2; Zhouqu, Renmingdigou, alt. 2780 m, 30/VII/ 2006, L. Lv 061274; Diebu, Yiwagou, alt. 3600 m, 25/VII/ 2006, Z.T. Zhao 060024; alt. 3680 m, 25/ VII/ 2006, X.L. Shi. 060070-2.

Remarks: The species is characterized by verrucose to sulcate apothecial disc margins (not evident in the young apothecia shown in Plate 2D), coarsely granular epihymenium, large crystals in the amphithecium, and the presence of atranorin alone. *Lecanora sulcata* is similar to *L. cinereofusca* and *L. insignis* in having discontinuous apothecial margin but can be distinguished from both species by the lack of pannarin.

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Neosporidesmium wuyishanense sp. nov. from southern China, and a first Chinese record of *Morrisographium ulmi*

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Abstract—A new species, *Neosporidesmium wuyishanense*, is described and illustrated from specimens collected on dead stems in Fujian Province. It differs from other *Neosporidesmium* species by its ellipsoidal or obclavate, 3–6-distoseptate conidia. *Morrisographium ulmi* is newly recorded from China.

Key words—hyphomycetes, taxonomy

Introduction

The genus *Neosporidesmium* Mercado & J. Mena was established by Mercado Sierra & Mena Portales (1988) for a single species, *N. maestrense*. Subsequently eleven other species have been described: *N. antidesmatis* Jian Ma & X.G. Zhang, *N. appendiculatum* I.B. Prasher & R.K. Verma, *N. diaoluoshanense* Xiang Y. Li & X.G. Zhang, *N. macrosporum* Prasher & R.K. Verma, *N. malloti* Jian Ma & X.G. Zhang, *N. micheliae* Y.D. Zhang & X.G. Zhang, *N. microsporum* W.P. Wu, *N. sinense* W.P. Wu, *N. subramanianii* Melnik et al., *N. vietnamense* Melnik & U. Braun, and *N. xanthophylli* Jian Ma & X.G. Zhang (Li et al. 2015, Ma et al. 2011, Mel'nik & Braun 2013, Mel'nik et al. 2016, Prasher & Verma 2014, 2015; Wu & Zhuang 2005, Zhang et al. 2011). Seven of these species have been recorded from China: *N. antidesmatis*, *N. diaoluoshanense*, *N. malloti*, *N. micheliae*, *N. microsporum*, *N. sinense*, and *N. xanthophylli*.

The genus is characterized by unbranched conidiophores aggregating into erect, cylindrical, dark brown to black synnemata, and integrated, terminal, monoblastic, lageniform or doliiform, determinate or percurrently extending conidiogenous cells that produce solitary, pale brown to brown, ellipsoidal or obclavate, smooth, distoseptate conidia. The criteria used for species delimitation are based mainly on proliferation of conidiogenous cells, conidial morphology, and overall conidiomatal size (Mercado & Mena 1988; Wu & Zhuang 2005).

During our ongoing survey of fungi associated with woody debris in subtropical forests of Fujian Province, two conidial fungi were collected on dead stems. One of them, with morphological characteristics of *Neosporidesmium* (Mercado Sierra & Mena Portales 1988), is described here as a new species, *N. wuyishanense;* the other is identified as *Morrisographium ulmi,* a new record from China. Specimens are conserved in the Herbarium of the Department of Plant Pathology, Shandong Agricultural University, Taian, China (HSAUP) and Herbarium Mycologium, Chinese Academy of Sciences, Beijing, China (HMAS).

Neosporidesmium wuyishanense H.H. Li & X.G. Zhang, **sp. nov.** Fig. 1

MycoBank MB 822164

Differs from other *Neosporidesmium* species by its ellipsoidal or obclavate conidia.

Type: China, Fujian Province: Wuyishan, on dead stems of an unidentified broadleaf tree, 22 Apr. 2016, J.W. Xia (**Holotype**, HSAUP H10373; **isotype**, HMAS 245640).

Etymology: *wuyishanense*, in reference to the type locality, Wuyishan.

Colonies on the natural substrate effuse, dark brown, hairy. Mycelium partly superficial, partly immersed in the substratum. Conidiomata synnematous, solitary, erect, dark brown to black, cylindrical, becoming narrower towards the apex, ≤1290 μm high and 120 μm diam. at the often swollen base. Conidiophores macronematous, synnematous, unbranched, septate, smooth, brown to dark brown, ≤1290 × 3.5–7.5 μm, diverging laterally and also terminally. Conidiogenous cells monoblastic, integrated, terminal, percurrent, determinate, smooth, ellipsoidal, brown to dark brown, 21–26.5 × 5–9 μm. Conidia holoblastic, solitary, dry, acrogenous, ellipsoidal or obclavate, 3–6-distoseptate, smooth wall, brown, apical cell pale brown, 30–60 × 5–9 μm.

Comments—*Neosporidesmium wuyishanense* superficially resembles *N. micheliae,* which differs by its broader (8.5–11 μm), obclavate conidia with more distosepta (7–8; Zhang et al. 2011).

Fig. 1. *Neosporidesmium wuyishanense* (holotype, HSAUP H10373).
A. Synnema; B. Conidiophore, conidiogenous cell, and developing conidium;
C. Conidia; D. Conidiogenous cells.

Morrisographium ulmi (E.F. Morris) Illman & G.P. White,
Can. J. Bot. 63: 424. 1985. FIG. 2

≡ *Phragmographium ulmi* E.F. Morris, Mycopath. Mycol. Appl. 28: 99, 1966.

SYNNEMATA dark brown to black, ≤325.5 μm high, cylindrical or sometimes flaring-out at apices, 12–59 μm diam. at the base. Inner fertile region composed of hyaline or pale, septate, branched hyphae, outer sterile region composed of dark brown, parallel, unbranched, septate hyphae. CONIDIA solitary, acrogenous, fusiform to falcate, mucoid, 6–9-septate, 58–76 × 2.5–2.7 μm.

SPECIMEN EXAMINED: **CHINA, FUJIAN PROVINCE**: Jiuxianshan, on dead stems of an unidentified broadleaf tree, 26 Apr. 2016, J.W. Xia (HSAUP H10371).

COMMENTS – *Phragmographium* E.F. Morris was erected by Morris (1966) with *P. ulmi* as the type species; however this genus is regarded as an illegitimate later near-homonym of *Phragmographium* Henn., as pointed out by Morelet (1968), who proposed *Morrisographium* M. Morelet as a substitute name, typified by *M. pilosum* (Earle) M. Morelet [≡ *Isariopsis pilosa* Earle; ≡ *P. pilosum* (Earle) E.F. Morris; = *M. persicae* (Schwein.) Illman & G.P. White]. This different typification was based on an erroneous opinion by Jong & Morris (1968) that: (1) *P. ulmi* was a synonym of the prior name *P. pilosum*; and (2) that *P. pilosum*'s priority somehow made it the "replacement" type species of the genus *Phragmographium*. This error was resolved by Illman & White's (1985) revision of *Morrisographium*, which demonstrated that *M. ulmi* and *M. pilosum* represented different species. *Morrisographium* is therefore a new genus [gen. nov.] typified by *M. pilosum*, and not (as Morelet intended) a replacement name [nom. nov.] for *Phragmographium* (typified by *P. ulmi*). *Morrisographium* is mainly characterized by erect, simple, dark synnemata with stipe and head and comprising a central cylinder of fertile hyphae with a cortex of sterile hyphae and conidia that are multiseptate, fusiform to falcate, mucoid, and produced singly and acrogenously at apices of conidiophores.

Morrisographium ulmi is reported for the first time from China. The Chinese specimen closely matches previous descriptions, except that the type material has longer synnemata (700 μm, Morris 1966; Illman & White 1985).

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Fig. 2. *Morrisographium ulmi* (HSAUP H10371).
A, B. Synnema; C. Conidiogenous cells; D. Conidia.

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Notes on *Vamsapriya* and *V. camagueyensis* comb. nov.

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Abstract—A new combination, *Vamsapriya camagueyensis*, is proposed to accommodate *Corynespora camagueyensis* based on the type of conidial septa. *Vamsapriya camagueyensis* is distinguished by blastocatenate, cylindrical, 6–9-euseptate, brown to reddish-brown conidia. A key to *Vamsapriya* species is provided.

Key words—asexual fungi, systematics, tropical fungi

Introduction

Vamsapriya Gawas & Bhat (Gawas & Bhat 2006), typified by *V. indica* Gawas & Bhat, is distinguished by erect, dark brown synnematal conidiomata composed of compact parallel, septate, smooth conidiophores and monotretic,

integrated or discrete, terminal, determinate conidiogenous cells that produce acrogenous, cylindrical or vermiform, blastocatenate, euseptate, phragmosporous, brown conidia seceding schizolytically (Gawas & Bhat 2006). Three other species, *V. bambusicola* D.Q. Dai et al., *V. khunkonensis* D.Q. Dai et al., and *V. mahabaleshwarensis* Pratibha & Bhat were subsequently added (Pratibha & Bhat 2008; Dai et al. 2014). Gawas & Bhat (2006), who commented on the similarities and differences of *Vamsapriya* compared with the closest genera *Didymobotryum* Sacc. and *Podosporium* Schwein., indicated that all three genera have tretic conidial ontogeny and euseptate conidia. Castañeda-Ruiz (1985) described *Corynespora camagueyensis*, which has several characters that clearly fit with *Vamsapriya* generic concept. Therefore a new combination, *V. camagueyensis*, is proposed.

Taxonomy

Vamsapriya camagueyensis (R.F. Castañeda) R.F. Castañeda, X.G. Zhang & Gusmão, **comb. nov.** Fig. 1

Index Fungorum IF552810

≡ *Corynespora camagueyensis* R.F. Castañeda, Deuteromyc. Cuba. Hyphomyc. 3: 11 (1985).

Conidiomata on the natural substratum synnematous, erect, scattered, hairy, amphigenous, dark brown to reddish-brown, ≤300 µm tall. Mycelium mostly immersed, composed of branched, septate, 2.5–4 µm diam., smooth, brown hyphae. Conidiophores macronematous, erect, straight, unbranched, cylindrical, compactly packed below, slightly sparse above, 0–2 enteroblastic percurrent extensions, 4–7-septate, smooth, brown, 100–300 × 3–6.5 µm. Conidiogenous cells monotretic, cylindrical, integrated, terminal, determinate or indeterminate with percurrent extensions doliiform to slightly clavate. Conidial secession schizolytic. Conidia acrogenous, blastocatenate, cylindrical, straight, 6–9-euseptate, mostly 7-septate, smooth, brown to reddish- brown, dry, 45–65 × 4–6 µm.

Specimen examined: **CUBA**, **Camagüey Province**, Sierra de Cubitas, Hoyo de Bonet, 21°36′N 77°47′W, on decaying leaves of *Drypetes lateriflora* (Sw.) Krug & Urb. (*Putranjivaceae*), 29 November 1984, coll. R.F. Castañeda-Ruiz (INIFAT C84/135, holotype).

Notes: *Vamsapriya camagueyensis* is superficially similar to *V. indica*, which differs by its cylindrical vermiform conidia that are 10–80 µm long, 2–12-euseptate, and constricted at the septa (Gawas & Bhat 2006) and its verruculose conidia with up to 20 septa on incubated substrate (Dai et al. 2014).

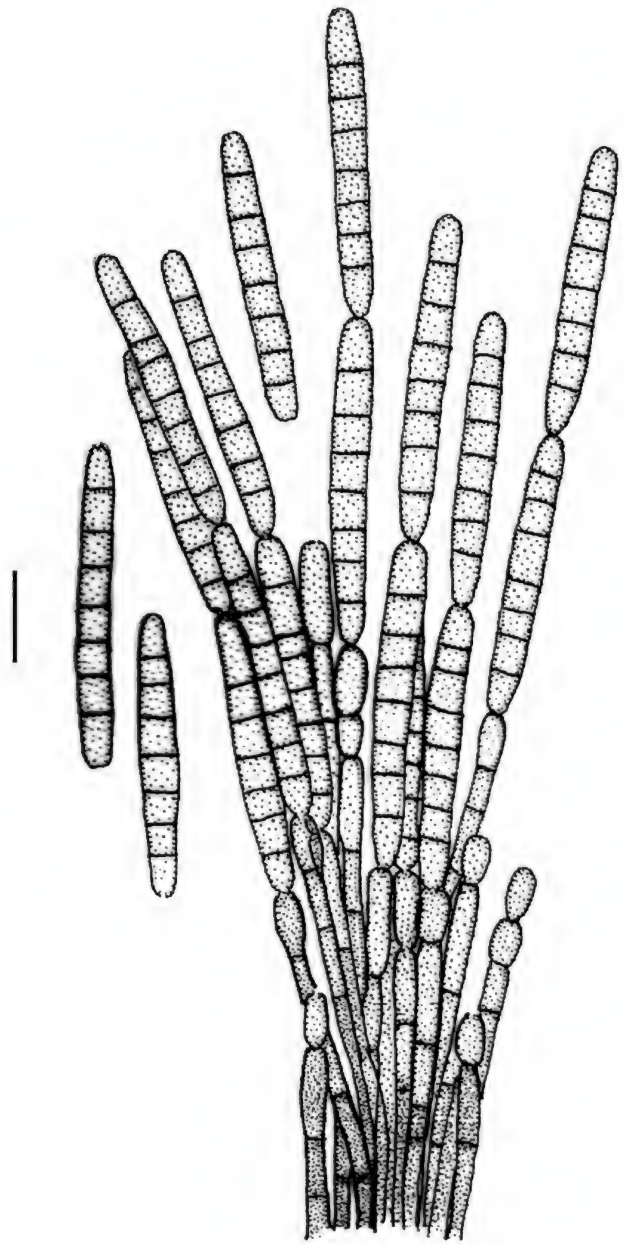

Fig. 1. *Vamsapriya camagueyensis* (INIFAT C84/135).
Detail of conidiogenous cells and conidia. Scale bar = 10 μm.

Dai et al. (2014) re-described the conidiogenous cells of *Vamsapriya* as "polytretic terminal or intercalary, monotretic, enteroblastic, ellipsoidal, wider at the apex", but their illustrations of *V. indica* depict only monotretic, integrated or discrete conidiogenous cells and their descriptions of *V. bambusicola* and *V. khunkonensis* mention only monotretic conidiogenous cells, which is in agreement with the generic concept of *Vamsapriya* (Gawas & Bhat 2006). *Vamsapriya mahabaleshwarensis* characterized by polytretic, terminal and intercalary conidiogenous cells and multi-branched conidial chains (Pratibha & Bhat 2008) deviates somewhat from the *Vamsapriya* generic concept that was considered a synonym of *Podosporium* by Seifert et al. (2011), but its conidia are solitary, usually obclavate or nearly so, slightly truncated, and somewhat cicatrized at the base.

Key to *Vamsapriya* species

1. Conidiogenous cells monotretic, conidial chains unbranched 2
   Conidiogenous cells polytretic, conidial chains multi-branched, conidia ovoid, ellipsoidal, or oblong, 0–4-septate, constricted at the septa, smooth or verruculose, pale brown to brown, 5–25 × 4–9 µm ..... *V. mahabaleshwarensis*
2. Conidia fusiform, 1–5-septate, constricted at the septa, straight or curved, verruculose, middle and basal cells dark brown, apical cell pale brown, 17.5–35 × 6–10 µm ..... *V. khunkonensis*
   Conidia not as above 3
3. Conidia cylindrical, vermiform, sometimes curved, 2–12-septate, constricted at the septa, brown, smooth, 10–80 × 4–6 µm ..... *V. indica*
   Conidia cylindrical, not vermiform, straight 4
4. Conidia 3–5-septate, brown to dark brown, smooth, 8–45 × 4.5–9.5 µm, basal cell smaller than the others ..... *V. bambusicola*
   Conidia 6–9-septate, brown to reddish-brown, smooth, 45–65 × 4–6 µm, rounded to obtuse at the ends ..... *V. camagueyensis*

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Wiesneriomyces machilicola sp. nov. from China

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Abstract—A new microfungus collected from dead leaves of *Machilus ichangensis* in China is described and illustrated as *Wiesneriomyces machilicola* (*Wiesneriomycetaceae, Dothideomycetes*). The species is distinguished by 3–6-celled, straight or falcate, hyaline conidia, 35–45 µm long.

Key words—anamorph, asexual ascomycota, microfungi, taxonomy.

Introduction

The genus *Wiesneriomyces* Koord. was erected by Koorders (1907), and typified by *W. javanicus* Koord. Kirk (1984), who identified *Volutellaria laurina* Tassi as an earlier synonym of *W. javanicus*, published the new combination *Wiesneriomyces laurinus* (Tassi) P.M. Kirk as the correct name for the species. Kuthubutheen & Nawawi (1988) described a second species, *W. conjunctosporus* Kuthub. & Nawawi.

A recently proposed genus, *Parawiesneriomyces*, is morphologically similar to *Wiesneriomyces* but can be differentiated by its sporodochia that are not elevated by a dark pseudoparenchymatous stalk and setae that are not directly linked to sporodochia but also develop without sporodochia (Crous et al. 2016).

An asexual fungus colonizing dead leaves of *Machilus ichangensis* collected from Duheyuan National Nature Reserve in Hubei, China, is proposed as a new species, described and illustrated here as *Wiesneriomyces machilicola*.

Materials & methods

Duheyuan National Nature Reserve, Guangdu, Zhushan county, Hubei, China was surveyed for hyphomycetes in September 2016. The collected specimens were first examined under an Olympus SZX7 stereomicroscope to prepare wet mounts, and microfungi were mounted in 85% lactic acid for further observation. The microfungi were examined and fungal structures were measured under a Zeiss Imager.M2 compound microscope with differential interference contrast (DIC). Photomicrographs were taken with a Zeiss Axiocam 506 color camera. Measurements of the fungal structures were made under a 100× objective lens and statistically analyzed for means and standard deviations with a 95% confidence interval of means.

The type specimen is deposited in U.S. National Fungus Collections, Beltsville, MD, U.S.A. (BPI).

Results

Taxonomy

Wiesneriomyces machilicola D.W. Li, Jing Y. Chen & Yi X. Wang, **sp. nov.** Fig. 1

MycoBank MB 819827

Differs from *Wiesneriomyces conjunctosporus* and *W. laurinus* by its shorter conidia with fewer cellular isthmuses and its almost unbranched conidiophores.

Type: China, Hubei, Zhushan county, Guangdu, Bailihe village, Yingzuiyan, Duheyuan National Nature Reserve, 31°52′18″N 110°08′56″E, dead leaves of *Machilus ichangensis* Rehder & E.H. Wilson (*Lauraceae*), Sept. 22, 2016, coll. Jing-Yuan Chen & Yi-Xun Wang (**Holotype**: BPI 910178).

Etymology: Latin, *machili-*, referring to *Machilus*, the host on which the holotype was collected; *-cola*, referring to inhabiting.

Asexual fungus. Colonies on natural substrate small, brown. Mycelium partly superficial, partly immersed in substrate, composed of branched, septate, hyphae, 2.1–4.5 µm wide, pale brown to brown. Conidiomata sporodochial, solitary, with 1–7 setae arising from the margins of the sporodochial stalk. Setae subulate, with acute apex, septate, thick-walled, dark brown to black, ≤178 µm long and 4.5–7.5 µm diam. at the base. Conidiophores semi-macronematous, arising close to one another, sometimes loosely aggregated, pale brown to brown toward the base, hyaline toward apex, septate, rarely branched. Conidiogenous cells monoblastic to polyblastic (mostly 2, rarely 1 or 3 conidia), discrete, determinate, terminate, clavate, hyaline to subhyaline, smooth, (5.6–)7–9.4(–10.6) × (2.4–)3.1–4.1(–4.2) µm (n = 20); Conidia in whitish mass sometimes becoming subhyaline, acrogenous, (3–)4–5(–6) cells connected by narrow cellular isthmuses; conidia (21.7–)35–45(–48) × 2–3 (–3.7) µm (n = 30), hyaline, smooth, slightly thick-walled, straight or falcate shaped, rarely sigmoid, unbranched; intermediate cells cylindrical, (7.5–)

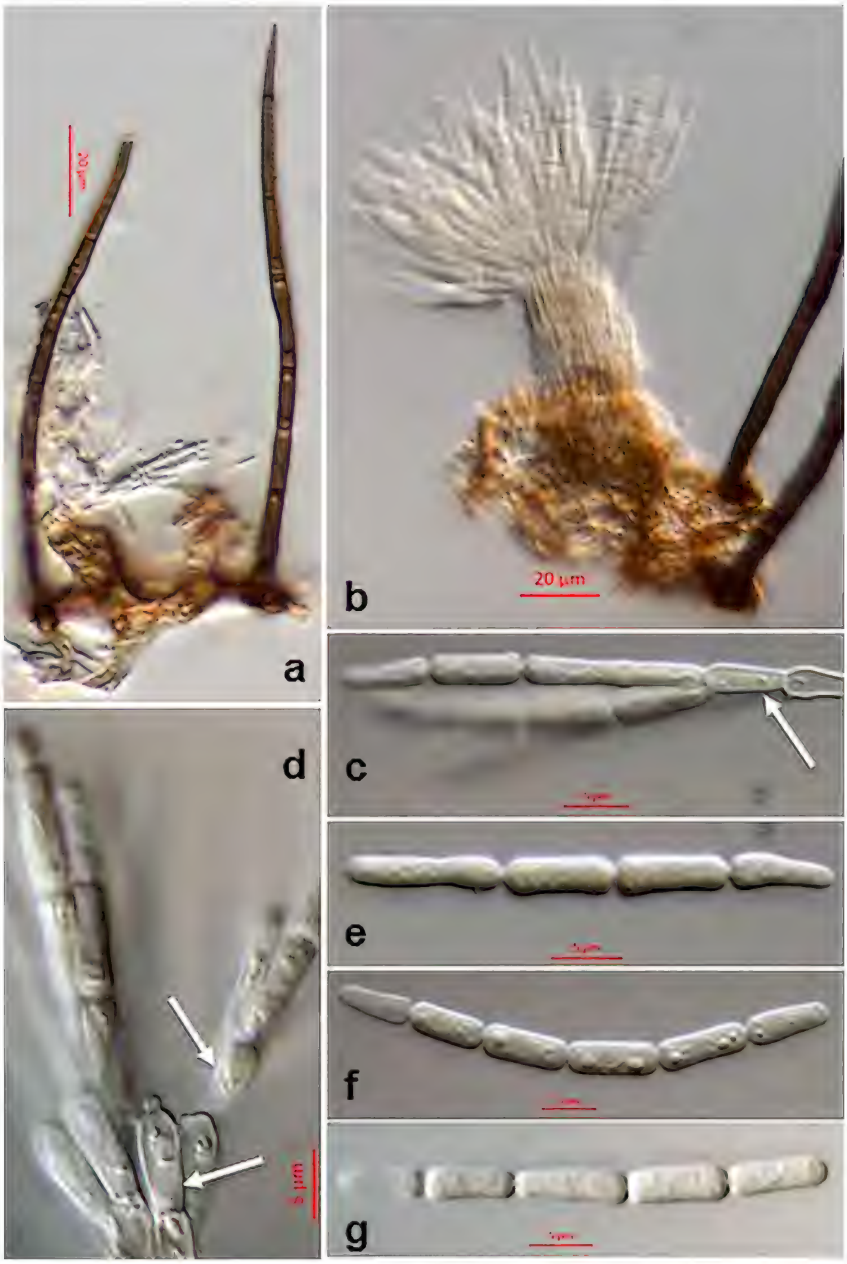

Fig. 1. *Wiesneriomyces machilicola* (holotype, BPI 910178): a, b. Setae, sporodochia, and conidia; c, d. Conidiogenous cells (arrowed) and immature conidia; e–g. Conidia. Scale bars: a, b = 20 µm; c–g = 5 µm.

8.5–11.3(–12.7) × (2.1–)2.3–3.1(–3.7) µm (n = 30); apical cell conical, (4.5–)5–8 (–9.6) µm (n = 26) long. Sexual state unknown.

Note: *Wiesneriomyces machilicola* is the third species included in *Wiesneriomyces*. Morphologically, *W. machilicola* can be distinguished from the two other species by its conidial size, setae, and conidiophores: *W. laurinus* has longer conidia (50–90 µm, with 6–8 cells) and much longer setae (≤476 µm; Maniotis & Strain 1968, Matsushima 1971), while *W. conjunctosporus* has much longer (280–360 µm) conidia with up to 15 cells and much longer (≤600 µm) setae (Kuthubutheen & Nawawi 1988).

Suetrong et al. (2014) determined from LSU and SSU phylogenetic analysis that *Wiesneriomyces* formed a monophyletic clade in the *Dothideomycetes* and proposed "*Wiesneriomycetaceae*" (nom. inval.) to accommodate *Wiesneriomyces*. Bezerra et al. (2016) proposed a new order, *Wiesneriomycetales* to accommodate *Wiesneriomyces*, *Parawiesneriomyces*, *Pseudogliophragma*, and *Speiropsis*.

Key to species of *Wiesneriomyces*

1. Conidiomata with incurved setae arising from a sporodochial stalk; conidia 50–90 µm long ..... *W. laurinus*
1. Conidiomata with setae arising from immersed mycelium around a sporodochial stalk 2
2. Conidia 280–360 µm long ..... *W. conjunctosporus*
2. Conidia 22–48 µm long ..... *W. machilicola*

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Gonatophragmiopsis verrucosa gen. & sp. nov. and *Pithomyces dimorphosporus* sp. nov. from Brazil

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Abstract—A new genus and species, *Gonatophragmiopsis verrucosa*, from decaying leaves of an unidentified *Annonaceae,* and a new species, *Pithomyces dimorphosporus*, from decaying leaves of an unidentified dicotyledonous plant, both collected in Brazil, are described and illustrated. *Gonatophragmiopsis verrucosa* is distinguished by distinct, erect, euseptate, unilateral branched, yellowish olivaceous-brown conidiophores; discrete, polyblastic conidiogenous cells; and cylindrical or long oblong, straight or curved, 0–7-septate, verrucose or verruculose, yellowish olivaceous-brown conidia. *Pithomyces dimorphosporus* is characterized by dimorphic conidia: type 1) ellipsoidal, oblong pyriform, obovoid to subglobose, 0–3-septate, echinulate or verrucose, non-rostrate; and type 2) obpyriform, verrucose, 1-septate, with a long rostrate apical cell.

Key words—*Ascomycota*, hyphomycetes, taxonomy, tropics

Introduction

The diversity of conidial fungi in the Brazilian semiarid region has received little attention. During a survey of hyphomycetes associated with decaying plant material from Bahia state, two conspicuous fungi were collected. One showed remarkable differences from all previously described genera (Seifert et al. 2011), and the other was determined as a *Pithomyces* that differed from all previously described *Pithomyces* species. They are both described here as new.

Materials & methods

Samples of litter were placed in paper bags for transport to the laboratory, where they were placed in Petri dish moist chambers and stored at 25°C for 30 days in a 170 L polystyrene box with 200 mL sterile water plus 2 mL glycerol (Castañeda-Ruiz et al 2016). Mounts were prepared in PVL (polyvinyl alcohol and lactic acid) and measurements were made at a ×1000 magnification. Micrographs were obtained with an Olympus BX51 microscope equipped with bright field and Nomarski interference optics. The specimens including holotype are deposited in the Herbarium of Universidade Estadual de Feira de Santana, Bahia, Brazil (HUEFS).

Taxonomy

Gonatophragmiopsis Gusmão, J.S. Monteiro & R.F. Castañeda, **gen. nov.**

MycoBank MB 822036

Differs from *Gonatophragmium* by its broadly flattened or concave, opaque, non-melanized conidiogenous loci and by its strongly verruculose or verrucose conidia, truncate at the base.

Type species: *Gonatophragmiopsis verrucosa* Gusmão et al.

Etymology: Latin, *Gonatophragmi-*, referring to the genus *Gonatophragmium*, + Greek, *-opsis*, meaning "resemblance, similitude".

Colonies on the natural substratum effuse. Mycelium mostly superficial. Conidiophores macronematous, mononematous, branched, septate, brown, yellow-brown, yellowish olivaceous-brown to brown. Conidiogenous cells polyblastic, discrete, sympodial. Conidiogenous loci broadly flatted or slightly concave, not melanized, opaque to obscure. Conidial secession schizolytic. Conidia solitary, unicellular to euseptate, cylindrical to long oblong, truncate at the base, pigmented.

Gonatophragmiopsis verrucosa Gusmão, J.S. Monteiro & R.F. Castañeda, **sp. nov.** Figs 1, 2

MycoBank MB 822037

Differs from all *Gonatophragmium* spp. by its broadly flattened or concave conidiogenous loci and by its strongly verruculose or verrucose basally truncate conidia.

Type: Brazil, Bahia State: Abaíra, 13°11′S 41°41′W, on decaying leaves of an unidentified *Annonaceae*, 16 May 2000, coll. L.F.P. Gusmão (**Holotype**: HUEFS 56638).

Etymology: Latin, *verrucosa*, referring to the small warts on conidial surface.

Colonies on the natural substratum effuse, hairy or somewhat funiculose, yellowish olivaceous brown to greenish yellow-brown. Mycelium mostly superficial, composed of branched, yellowish brown, strongly and tightly verrucose or verruculose but with smooth and basally constricted branches, 2.5–4 µm, with several pigmented granules in somatic cells. Conidiophores

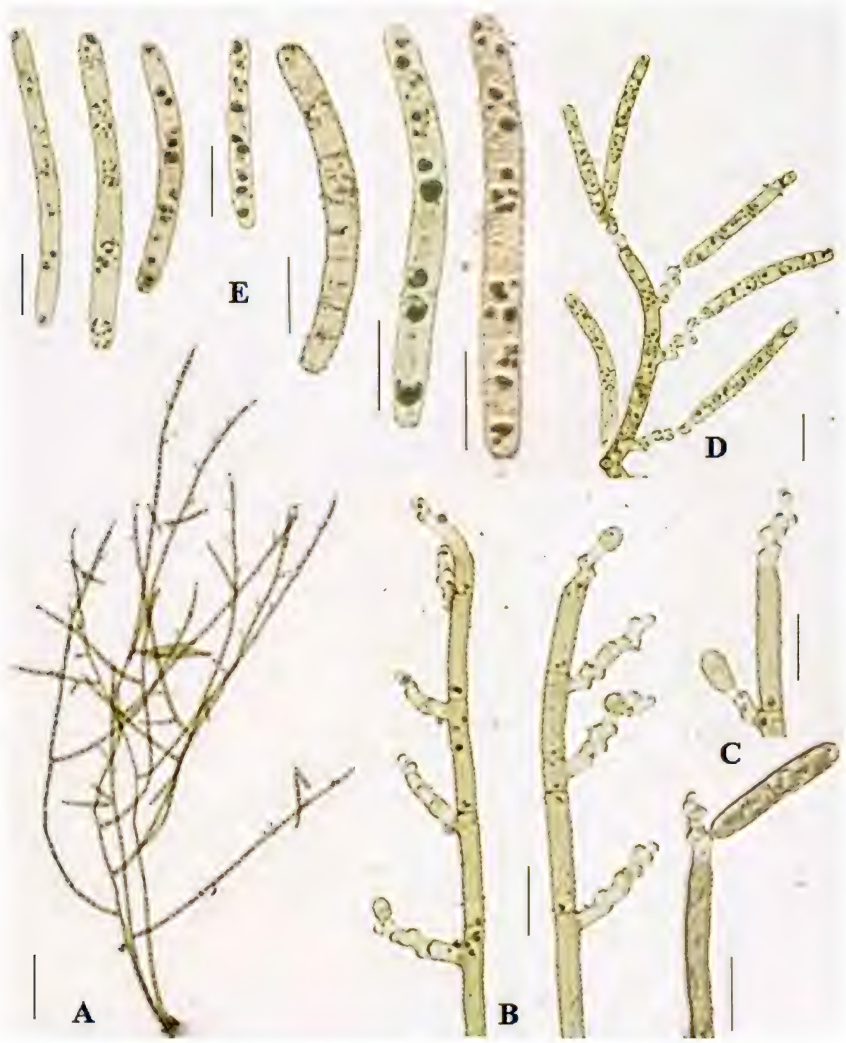

Fig. 1. *Gonatophragmiopsis verrucosa* (holotype, HUEFS56638). A. General aspect. B. Branches with conidiogenous cells. C, D. Conidiogenous cells with conidia. E. Conidia. Scale bars: A = 50 µm; B–E = 10 µm.

macronematous, mononematous or somewhat grouped, branched, mostly unilaterally branched, yellowish brown, strongly and tightly verrucose or verruculose, but with smooth and basally constricted, multiseptate, 350–500 × 4–5 µm. Conidiogenous cells polyblastic, cylindrical, geniculate

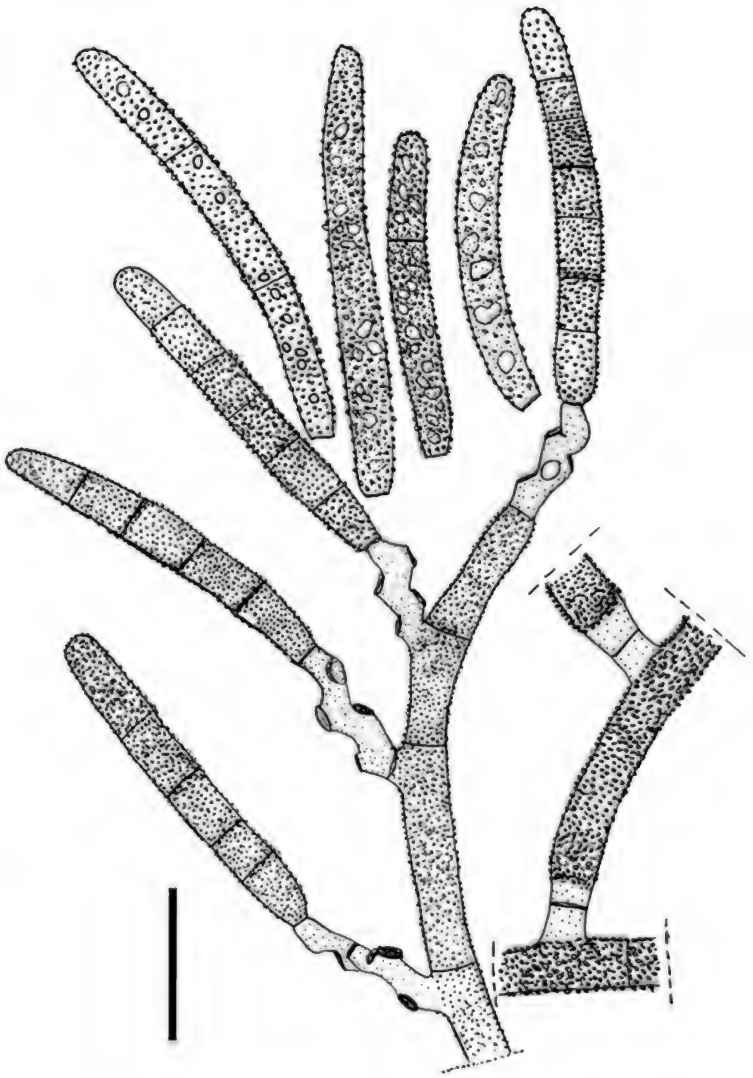

FIG. 2. *Gonatophragmiopsis verrucosa* (holotype, HUEFS56638).
A. Conidia, conidiophores, and conidiogenous cells. B. Detail of bases of branches.
Scale bar = 10 μm.

toward the apex, sometimes terminal, integrated mostly discrete, intercalary, indeterminate with sympodial extensions, 5–20 × 2.5–4 μm. CONIDIA solitary, acropleurogenous, cylindrical, long oblong, mostly curved, sometimes

straight, rounded at the apex, broadly truncated at the base, tightly verrucose or verruculose, 0–7-septate, weakly euseptate, 17–60 × 3.5–4.5 µm, yellowish olivaceous-brown, with several pigmented granules in the lumen.

Comments: *Gonatophragmium* Deighton is superficially similar to *Gonatophragmiopsis* in its unilaterally branched conidiophores and the mostly intercalary, discrete, sympodially extended conidiogenous cells, but *Gonatophragmium* has denticulate conidiogenous loci that are located in typically nodulose swollen areas of the conidiogenous cells, and the conidia are oblong or short cylindrical, mostly curved, attenuate at the base (Deighton 1969). *Stenella* Syd. is somewhat similar to *Gonatophragmiopsis* in its geniculate, sympodially extended conidiogenous cells but is distinguished by conidiophores that are not (or only sparingly) branched, frequently arise from dark pigmented stromata, and with cicatrized conidiogenous loci and by conidia that usually form branched lateral and acropetal chains (Seifert et al. 2011). *Zasmidium* Fr. also resembles *Gonatophragmiopsis* but is distinguished by small conidiogenous loci and conidia with a thickened, basal hilum (Singh et al. 2013). The conidial ontogeny in *Gonatophragmiopsis* is strongly reminiscent of that found in the conidial morph of *Hypoxylon* as illustrated and described by Jong & Rogers (1972).

Pithomyces dimorphosporus Gusmão, J.S. Monteiro & R.F. Castañeda, **sp. nov.** Figs 3, 4

MycoBank MB 822038

Differs from all *Pithomyces* spp. by its dimorphic conidia, produced on the same hyphal conidiomata: either subglobose, oblong, ellipsoidal, pyriform or broadly obovoid, non-rostrate; or obpyriform, with a whip-shaped, long rostrate apical cell.

Type: Brazil, Bahia State: Morro do Chapéu, on decaying leaves of an unidentified dicotyledonous plant, 11°35′S 41°12′W, 25 March 2008, coll. L.F.P. Gusmão (**Holotype**: HUEFS 216670).

Etymology: Greek, *di-*, meaning "two", + Greek *-morpho-*, meaning "shaped, form", Latin, *+-sporus*, referring to the conidia.

Colonies on the natural substratum effuse, hairy, pustule-like to punctuate, brown to dark brown. Mycelium mostly superficial, composed of branched, pale brown, smooth hyphae, 1.5–2.5 µm diam. Conidiophores macronematous, mostly reduced to conidiogenous cells. Conidiogenous cells monoblastic, cylindrical, determinate, pale brown, 4–9 × 1.5–2.5 µm. Conidial secession rhexolytic. Conidia solitary, acrogenous, dimorphic, verruculose, verrucose, tuberculate or echinulate, dark reddish-brown to dark brown, with a distinct basal frill 1.5–2 µm diam.: type 1) non-rostrate, subglobose, ellipsoidal,

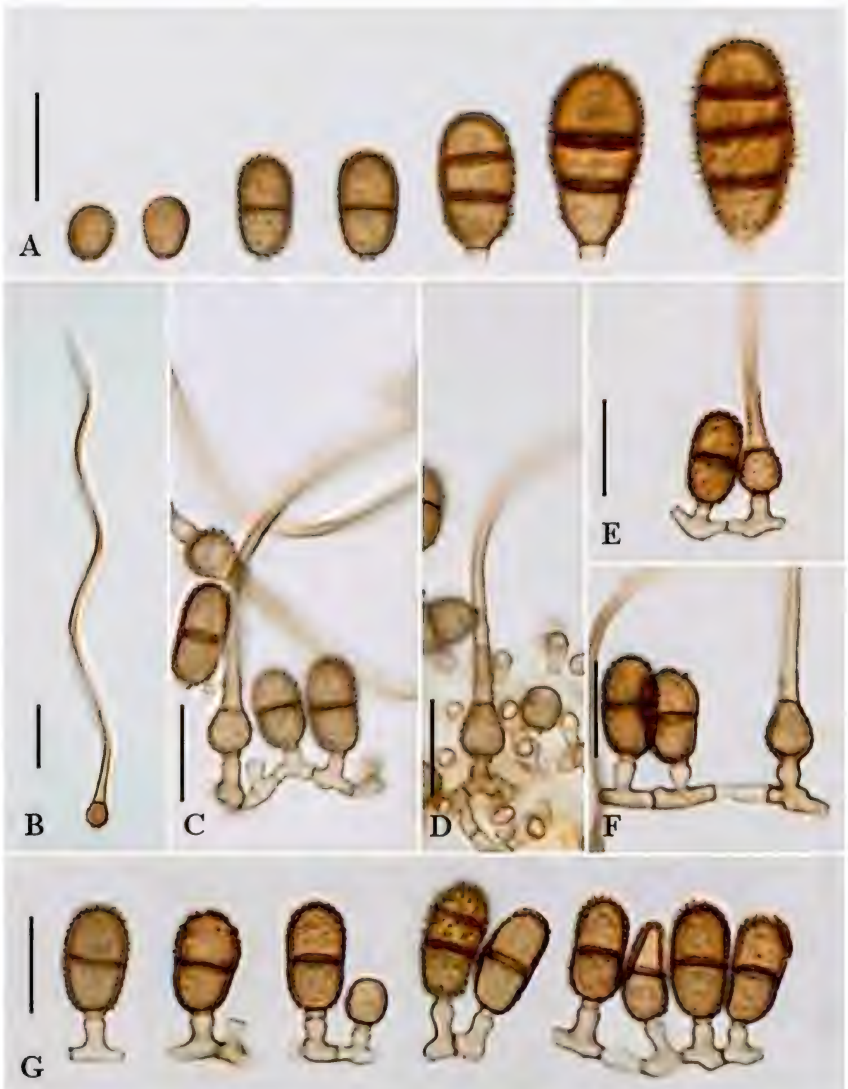

Fig. 3. *Pithomyces dimorphosporus* (holotype, HUEFS216670). A, B. Conidia. C–G. Detail of conidiogenous cells and conidia. Scale bars = 10 µm.

oblong, pyriform, or broadly obovoid, (0–)1(–3)-septate [0-septate 4–6 × 3–4 µm, 1-septate 9–11 × 5–6 µm, 2-septate 10–16 × 5–7 µm, 3-septate 24–27 × 10–12 µm] verrucose or echinulate; type 2) rostrate, brown or reddish brown,

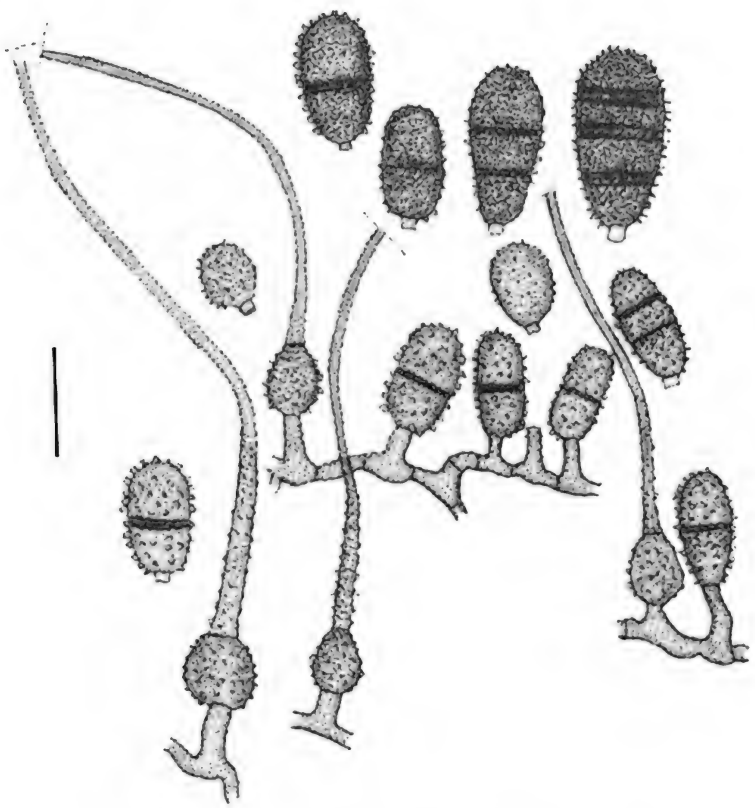

Fig. 4. *Pithomyces dimorphosporus* (holotype, HUEFS 216670). Conidiogenous cells and conidia. Scale bar = 10 µm.

1-septate, with an obpyriform, verrucose basal cell, 4–7 × 4–5 µm, and a whip-shaped, long rostrate apical cell, 75–110 µm long, verruculose below, smooth above.

Comments: *Pithomyces* Berk. & Broome is distinguished by macronematous or semi-macronematous conidiophores; monoblastic, integrated or discrete conidiogenous cells; and ellipsoidal, oblong, pyriform conidia that secede rhexolytically. Among 46 described *Pithomyces* species, only *P. cupaniae* (Syd.) M.B. Ellis, and *P. graminicola* R.Y. Roy & B. Rai are superficially similar to *P. dimorphosporus* (Ellis 1971, 1976; Zhang & Zhang 2003, 2007): *P. cupaniae* is distinguished by conidia that are oblong-clavate to fusiform, 1-septate, pale

to mid olivaceous brown, and 10–20 × 3–5 µm (Ellis 1971) while *P. graminicola* produces conidia that are cylindrical or clavate, 1–2-septate, straw-colored to olivaceous brown, and 12–15 × 6–7 µm (Ellis 1976).

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Eight new records of lichenized and lichenicolous fungi from Turkey

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Abstract—From Akdağ, Aegean Region, Turkey, four lichenized fungi (*Circinaria elmorei*, *Gyalidea fritzei*, *Placynthium lismorense*, *Rhizocarpon atroflavescens* subsp. *pulverulentum*), three lichenicolous lichens (*Buellia uberior*, *Endohyalina brandii*, *Rhizocarpon vorax*), and one lichenicolous fungus (*Phaeospora parasitica*) are reported for the first time from Turkey. Comments on their habitats, substrata, and key anatomical features and photographs are provided for each species.

Key words—*Ascomycota*, Afyon, Denizli, biodiversity

Introduction

Lichenized and lichenicolous fungal biota of Turkey are much better known than compared with 20 years ago. Now approximately 1300 species of lichenized fungi (Halıcı 2015, Kocakaya & Halıcı 2015, Yavuz et al. 2015) and 200 species of lichenicolous fungi (Halıcı 2008, Halıcı et al. 2013, Kocakaya et al. 2015) are known from the country. Nonetheless, this number should be higher, as there are many areas in Turkey that have never been explored lichenologically (Halıcı et al. 2007).

All new records given in this paper were collected in Akdağ, within the Afyon and Denizli city borders in the Aegean area of Turkey. Previously, one lichenicolous fungus, *Stigmidium humidum* Pérez-Ortega et al., was described from Afyon Province and two, *Llimoniella muralicola* Halıcı and *Phoma recepii* Halıcı & Candan, from Denizli Province (Halıcı 2008,

Halıcı et al. 2014, Pérez-Ortega et al. 2010). Despite floristic studies carried out in the provinces of Afyon (Çobanoğlu & Yavuz 2006, Kınalıoğlu & Aptroot 2012) and Denizli (Şenkardeşler & Sukatar 2006, Yavuz & Çobanoğlu 2007), the lichen floras of these provinces are far from complete. Here we add information on eight lichenized and lichenicolous fungi collected from Akdağ (Afyon, Denizli), all of which represent new records for Turkey.

Material & methods

The specimens are deposited in the Anadolu University Herbarium, Eskişehir, Turkey (ANES). They were examined by standard microscopic techniques using a Leica MZ6 model stereo microscope and a Zeiss Axio Imager A2 model light microscope. The macro photographs were taken with a Leica DFC 320 and a Panasonic Lumix DCM-TZ10. Hand-cut sections were studied mostly in water, but if necessary potassium hydroxide (KOH) and Lugol's solution (I) were also used. Measurements were taken in water. Ascospores were measured from five different ascoma for each species; the data are given as minimum–maximum from N measurements. The descriptions below are based on the Turkish specimens.

Taxonomy

Buellia uberior (Nyl.) Anzi, Atti Soc. Ital. Sci. Nat. 9: 252. 1888. Fig. 1

A facultative lichenicolous lichen on a *Schaereria fuscocinerea* thallus. Thallus shiny, grayish to pale gray with a prothallus. Apothecia black, shiny, lecideine, superficial, mostly on the edges of the areoles. Epihymenium greenish, hymenium 45–60 µm tall. Medulla C+ red (gyrophoric acid), K+ yellow, I+ violet. Ascospores of the *Buellia*-type, brown, with striate ornamented walls, 9–12 × 5–7 µm (N = 20).

Specimen examined: **TURKEY, Denizli, Çivril,** Akdağ, northwestern slopes of Akdağ, *Pinus nigra* forest, 38°24′09″N 29°59′12″E, alt. 1375–1400 m, parasitic on the thallus of *Schaereria fuscocinerea* on siliceous rocks, 9 June 2008, M. Candan (ANES 14769).

The Turkish specimen collected on *Schaereria fuscocinerea* is parasitic on the host thallus, eventually destroying it. The host was found on the north faces of siliceous rocks with lichens such as *Rhizocarpon geographicum*, *Lecanora sulphurea*, and *Tephromela atra*.

The Turkish specimen agrees with the descriptions of Scheidegger (1987, 1993). The other lichenicolous *Buellia* species growing on *Schaereria* spp. is *B. miriquidica* Scheid., differing in its psilate ascospore walls and chemistry (miriquidic acid; Scheidegger 1987, 1993).

Circinaria elmorei (E.D. Rudolph) Owe-Larss., A.Nordin & M.Sohrabi, Biblioth. Lichenol. 106: 244. 2011. FIG. 2

Thallus more or less verrucose; c. 2 cm diam. and c. 1–1.5 mm thick; areoles more or less convex. Apothecia aspicilioid, abundant and almost totally covering the entire thallus surface, 0.5–1.5 mm diam., round to elongated; disc usually black, but appearing bluish because of the white pruina; thalline margin very thick, darker than the thallus, almost black. Epihymenium olive brown; hymenium hyaline, I+ blue; 150–170 µm tall. Asci clavate; 4-spored. Ascospores hyaline, simple, globose to subglobose, 20–26(–30) × 20–23 µm (N = 30). Pycnidia not observed.

SPECIMENS EXAMINED: **TURKEY**, **AFYON**, **Sandıklı**, Akdağ, west of Reşadiye Village, steppe, 38°24′58″N 30°09′51″E, on small calcareous rocks near ground, alt. 1120 m, 8 June 2008, M. Candan (ANES 18606); **Kızılören**, Akdağ, west of Kızılören, calcareous rocks, *Quercus* sp. communities, 38°14′50″N 30°08′10″E, alt. 1166 m, on small calcareous rocks near ground, 28 September 2007, M. Candan (ANES 14636); **Dinar**, east of Cerityaylası Village, 38°21′20″N 30°06′54″E, alt. 1510 m, on calcareous rocks, 4 June 2008, M. Candan (ANES 18670); northwest of Karakuyu Village, 38°05′22″N 30°11′06″E, alt. 1040 m, calcareous rocks, 8 June 2008, M. Candan (ANES 17215); **DENIZLI**, **Çivril**, Akdağ, Kurucova Hill, 38°20′26″N 29°57′33″E, alt. 1881 m, on small calcareous rocks near ground, 5 June 2008, M. Candan (ANES 18471).

The Turkish specimens agree with the description of Owe-Larsson et al. (2011). *Circinaria elmorei* is first described in 1953 in New Mexico, USA by R.D. Rudolph based on *Lecanora elmorei*. *Circinaria elmorei* (saxicolous and non-vagrant) is morphologically similar to the European *Aspicilia desertorum* (Kremp.) Mereschk. which is illegitimate name since it represents more than one taxon (Owe-Larsson et al. 2011). Within this study, *Circinaria elmorei,* which was collected on the calcareous rocks and small stones, represents the first record from Turkey under this name.

Endohyalina brandii Giralt, van den Boom & Elix, Mycol. Progr. 9(1): 41. 2010. FIG. 3

A lichenicolous lichen on the thallus of *Aspicilia intermutans*. Thallus absent (endokapylic). Apothecia common, lecideine, black, adnate to sessile, 0.1–0.2 mm diam., mostly on the edges of the host thallus areoles or apothecia. Epihymenium brown to dark brown, hymenium hyaline but sometimes with a slight olive tinge, hypothecium brown to reddish brown. Ascospores brown, *Dirinaria*-type when young but *Physconia*-type when mature, 12–16(–19) × 6–9(–10) µm (N = 20). Pycnidia not observed.

Specimen examined: **TURKEY, Afyon, Sandıklı,** Akdağ, Başalan Plateau, location of Derealanı, *Pinus nigra* forest, 38°19′03″N 30°02′09″E, alt. 1453 m, on the thallus of *Aspicilia intermutans*, 3 June 2008, M. Candan (ANES 18367).

This obligately lichenicolous lichen species was described on *Aspicilia intermutans* and is previously known only from the Canary Islands and the Iberian Peninsula (Giralt et al. 2010, Nadyeina et al. 2010). This new record from Turkey extends the known distribution of *Endohyalina brandii,* which should be searched for elsewhere on *Aspicilia* spp. growing on siliceous rocks. The Turkish specimen has no visible thallus and produces longer and broader ascospores than originally described by Giralt et al. (2010).

Gyalidea fritzei (Stein) Vězda, Folia Geobot. Phytotax. 1: 324. 1966. Fig. 4

Thallus rimose-areolate, slightly rusty red to yellowish. Apothecia common, emergent but immersed when young, sessile, sometimes grouped (2–3 apothecia together), disc concave, disc and margin dark brown to blackish, although the margin is usually pruinose. Asci 8-spored, dextrinoid, 70–100 × 20–25 µm (N = 10). Ascospores slightly constricted in the middle, muriform, olivaceous green, 17–23 × 12.5–15 µm (N = 10). Gelatinous sheath distinct, nearly 3 µm thick. Conidia 3–5 × 1 µm (N = 10).

Specimen examined: **TURKEY, Afyon, Sandıklı,** Akdağ, Başalan Plateau, location of Derealanı, *Pinus nigra* forest, 38°19′03″N 30°02′09″E, alt. 1453 m, on siliceous rocks in shaded situation, 3 June 2008, M. Candan (ANES 18731).

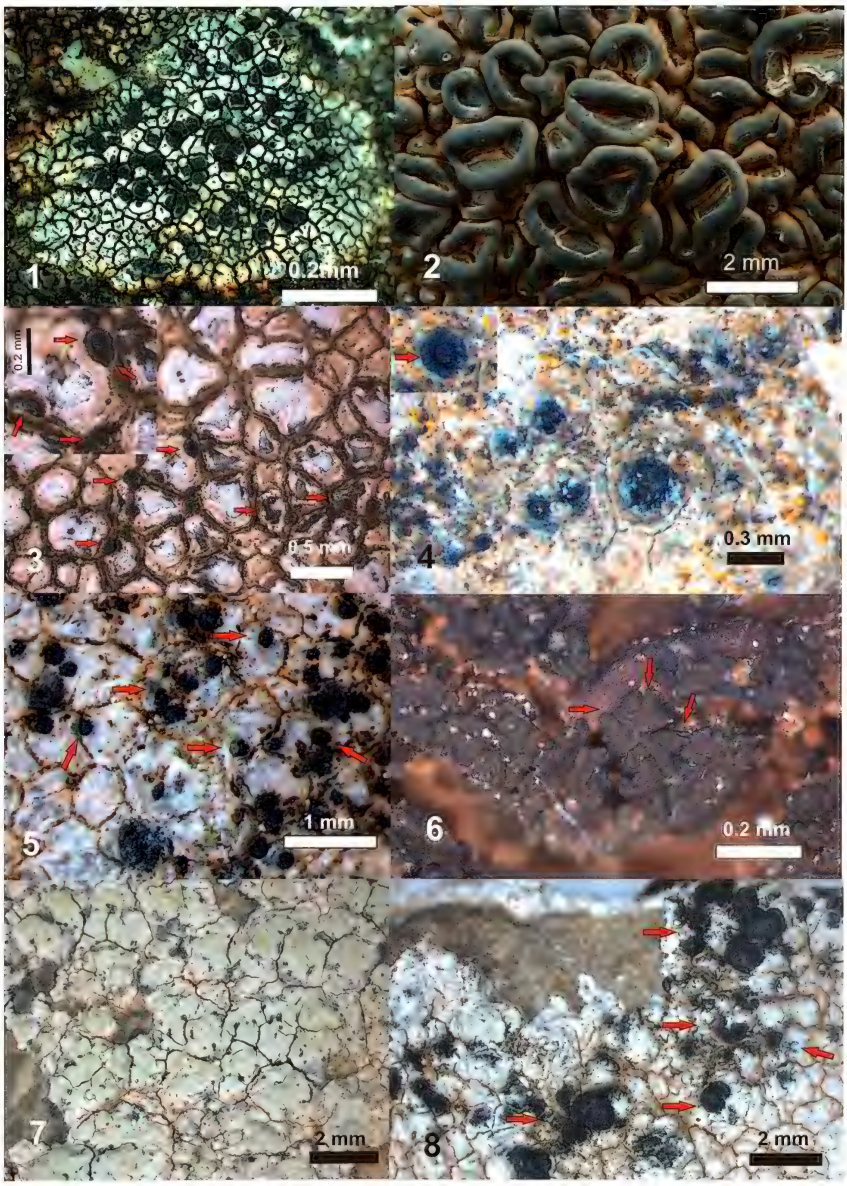
The Turkish specimen was collected on siliceous rocks near a stream in a shady and relatively humid habitat; it agrees with the description of Vězda (1966) and Wirth et al. (2013). *Gyalidea fritzei* is known from Europe (Vězda 1966, Orange 1990) and North America (Hutten et al. 2013). New to Asia.

Phaeospora parasitica (Lönnr.) Arnold, Flora 57: 151. 1874. Fig. 5

Lichenicolous fungus on *Rhizocarpon umbilicatum.* Ascomata perithecia, black, immersed to sessile on the host areoles, mostly arising singly, 0.1–0.2 mm diam. Asci 8-spored. Ascospores hyaline when young but brown when mature, mostly 3-septate, the over-mature ascospores have constricted walls near the septa, 17–20 × 6–8 µm (N = 10).

Specimen examined: **TURKEY, Afyon, Sandıklı,** Akdağ, Başalan Plateau, location of Derealanı, *Pinus nigra* forest, 38°19′03″N 30°02′09″E, alt. 1453 m, on the thallus of *Rhizocarpon umbilicatum* on siliceous rocks, 3 June 2008, M. Candan (ANES 18730).

The Turkish specimen was collected on the areoles of *Rhizocarpon umbilicatum* on siliceous rocks; it agrees with the descriptions of Vězda (1963) and Alstrup & Hawksworth (1990). In the infected areoles of the host lichen distinct bleaching



Figs 1–8. **1.** *Buellia uberior* on the thallus of *Schaereria fuscocinerea*; **2.** *Circinaria elmorei*; **3.** *Endohyalina brandii* (arrow) on the thallus of *Aspicilia intermutans*; **4.** *Gyalidea fritzei*, apothecium (arrow); **5.** *Phaeospora parasitica* (arrow) on the thallus of *Rhizocarpon umbilicatum*; **6.** *Placynthium lismorense* (arrow); **7.** *Rhizocarpon atroflavescens* subsp. *pulverulentum*; **8.** *Rhizocarpon vorax* (arrow) on *Pertusaria* sp.

was observed. *Phaeospora parasitica* is a common parasitic lichenicolous fungus on *Rhizocarpon* spp., especially in northern Europe (Ihlen & Wedin 2008, Alstrup & Hawksworth 1990). Alstrup & Hawksworth (1990) reported this fungus from Greenland on various crustose lichens but the specimens reported on hosts other than *R. umbilicatum* should be re-examined (Sérusiaux et al. 1999).

Placynthium lismorense (Cromb.) Vain., Ark. Bot. 8(4): 98. 1909. FIG. 6

Thallus dark brown to black, with well-developed lobes at the margin, ≤10 mm diam., prothallus not visible. Apothecia rare, c. 0.5 mm diam., blackish with a distinct thalline margin. Ascospores 1-septate, hyaline, usually slightly curved, 11–16 × 5–6 µm (N = 10). Pycnidia not observed.

SPECIMENS EXAMINED: **TURKEY**, **AFYON**, **Sandıklı**, Akdağ, Başalan Plateau, location of Derealanı, *Pinus nigra* forest, 38°19′03″N 30°02′09″E, alt. 1453 m, on calcareous soil, 3 June 2008, M. Candan (ANES 19060); **Kızılören,** Akdağ, west of Gülyazı Village, 38°14′29″N 30°05′54″E, alt. 1300 m, on calcareous soil, 28 November 2007, M. Candan (ANES 17454).

This cyanolichen is known from Europe (Köfaragó-Gyelnik 1940, Czeika & Czeika 2007, Carballal & Paz-Bermúdez 2008). The Turkish specimens were collected on hard soil in the crevices of calcareous rocks with *Catapyrenium squamulosum*; they agree with the descriptions of *Placythium lismorense* by Czeika & Czeika (2007) and Smith et al. (2009).

Rhizocarpon atroflavescens* subsp. *pulverulentum (Schaer.) Runemark, Opera Bot. 2(1): 132. 1956. FIG. 7

Thallus areolate, very pale yellowish, and mostly strongly pruinose. Prothallus whitish, blue-green and thick. Apothecia mostly in the margin of the areoles, mostly immersed, black. Epihymenium reddish, K+ red. Asci 8-spored. Ascospores muriform, greenish when young, dark brown when mature, 23–36 × 13–20 µm (N = 20).

SPECIMEN EXAMINED: **TURKEY**, **AFYON**, **Kızılören,** Akdağ, west of Kızılören, *Quercus* sp. communities, 38°14′50″N 30°08′10″E, alt. 1166 m, on slightly calcareous rocks, 28 November 2007, M. Candan (ANES 14716).

Rhizocarpon atroflavescens is easily distinguished from other yellow *Rhizocarpon* species by its whitish and irregularly subdivided areolae and relatively small and sparsely septate ascospores (Runemark 1956, Wirth et al. 2013). There are two subspecies: *R. atroflavescens* subsp. *pulverulentum* differs from *R. atroflavescens* Lynge subsp. *atroflavescens* by having a thicker thallus and Pd+ areolae (Runemark 1956). *Rhizocarpon atroflavescens* subsp.

pulverulentum is known from the Alps, the Pyrenees and the Scandinavian Mountains (Runemark 1956, Llimona 1976). The Turkish specimen agrees with the descriptions of Runemark (1956) and Wirth et al. (2013) and represents a new record for Asia.

Rhizocarpon vorax Poelt & Hafellner, Herzogia 6(1–2): 311. 1983. FIG. 8

A lichenicolous lichen on the thallus of *Pertusaria* sp. Thallus completely immersed in the host lichen and hardly visible. Apothecia black, without margin, rounded, 0.1–0.2 mm diam. Asci 8-spored, 100–110 × 30–40 µm (N = 10). Ascospores greenish when young (later brown), muriform, mostly 4–6-celled, 26–36 × 15–22 µm (N = 20).

SPECIMEN EXAMINED: **TURKEY**, **AFYON**, **Sandıklı**, Akdağ, Başalan Plateau, location of Derealanı, *Pinus nigra* forest, 38°19′03″N 30°02′09″E, alt. 1453 m, on the thallus of *Pertusaria* sp. on siliceous rocks, 3 June 2008, M. Candan (ANES 17460).

Rhizocarpon vorax was found as a parasitic and obligate lichenicolous lichen on *Pertusaria* sp. on siliceous rocks in more or less humid habitat in Turkey. The Turkish specimen agrees with the description of Poelt & Hafellner (1982) and represents a new record for Asia.

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Zygosporium verruciferum sp. nov., on *Solanum lycopersicum* from Venezuela

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Abstract — *Zygosporium verruciferum* is described and illustrated as a new species distinguished by its conspicuous and distinctive verrucose hyphae; its setiform conidiophores, which are verrucose and dark brown at the base, and smooth, globose and subhyaline toward the apex; and its unicellular; ellipsoidal, subhyaline conidia.

Key words — asexual fungi, hyphomycete, tomato

Introduction

The genus *Zygosporium* Mont. is characterised by development of darkly pigmented, incurved vesicular cells, which may develop on a setiform conidiophore or arise directly from the mycelium. the cell vesicle gives rise to 2–4 ampulliform conidiogenous cells; and the conidia are unicellular, hyaline to brown, smooth or variously ornamented, and ellipsoid, globose or ovoid (Hughes 1951, Ellis 1971, Whitton et al. 2003, McKenzie et al. 2007).

During investigations on a greenhouse *Solanum lycopersicum* (tomato) crop in Miranda State, Venezuela, a fungus representing the genus *Zygosporium* was observed. It differs morphologically from previously described species and is therefore described as a new species.

Materials & methods

Sepals of *Solanum lycopersicum* were collected from plants grown in a greenhouse and taken to the laboratory in sterile plastic bags. Samples incubated at 25°C in Petri dishes were placed inside 8 L plastic moist chambers containing 32 ml sterile water and

0.32 ml glycerol (Castañeda-Ruíz 2005) for 24h. Mounts were prepared with glycerin and with hydrous lactophenol 1:1, and examination and measurements were made at a magnification of 2000×. Micrographs were obtained with a Nikon D810 camera attached to a standard Carl Zeiss microscope and duplicator. Type specimens were deposited at National Herbarium Venezuela, Universidad Central de Venezuela, Caracas, Venezuela (VEN), and herb. L. Lucena, Caracas, Venezuela (CLL).

Taxonomy

Zygosporium verruciferum L. Lucena **sp. nov.** Figs 1–7

MycoBank 821676

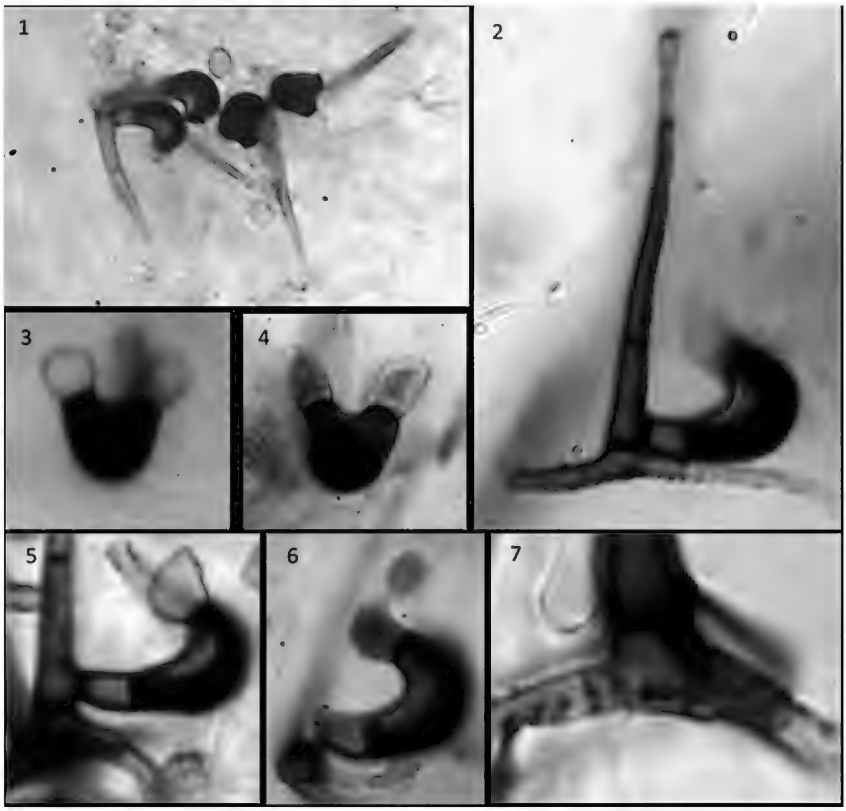
Differs from other *Zygosporium* species by its verrucose vegetative hyphae with warts that darken near setiform conidiophores; and from *Z. bioblitzi*, *Z. geminatum*, *Z. oscheoides*, and *Z. pacificum* by its smaller conidia.

Type: Venezuela, Miranda State, Municipio Guaicaipuro, Parroquia El Jarillo, Sector Quebrada Honda, 10°20′41″N 67°09′32″W, 1339 m a.s.l., on sepals of *Solanum lycopersicum* L., 17.XI.2015, coll. A. Vera, LL1112015 (**Holotype:** VEN 332005; **isotype**: CLL 1112015-2).

Etymology: From the Latin *verrucosum*, referring to the warts on the mycelium.

Colonies effuse on the natural substratum, forming an irregular shaped patch, amphigenous, brown. Mycelium superficial, decumbent. Hyphae 2–4 µm diam., hyaline, subhyaline to pale brown, cylindrical, septate, branched; with hyaline, pale brown to dark brown warts (<0.52 µm diam.), mostly near setiform conidiophores. Conidiophores setiform and vesicular, slightly curved, erect to flexuous, smooth, 2–3-septate; at the apical septum, brown, 42–57 × (2–)4–5 µm to 2–4 µm; apical cell clavate, hyaline to subhyaline, (4–)7–13 × 1–2 µm, basal cell dark brown, verrucose to tuberculate. Vesicles borne laterally on a short branch just above the conidiophore base, brown to darkish brown, thick, smooth, inflated, uncinate, 10–12 × 10–11 µm. Conidiogenous cells monoblastic, discrete, determinate, smooth, subhyaline to very pale brown, lageniform, ampulliform to globose, sometimes slightly curved, 4–6 × 4–5 µm. Conidia solitary, ellipsoidal, unicellular, smooth, hyaline, dry, subhyaline, 5–6 × 4–5 µm.

Comments—The most striking difference between *Z. verruciferum* and all other *Zygosporium* species is its warty dark hyphae, especially under the setiform conidiophores. No other species of the genus shows this character on the vegetative hyphae. *Zygosporium verruciferum* shares ellipsoidal conidia, two conidiogenous cells per vesicle, and setiform conidiophores with *Z. bioblitzi* McKenzie et al., *Z. geminatum* S. Hughes, and *Z. pacificum* Whitton et al., three species that are easily distinguished by their larger, ornamented conidia (Ellis



Figs 1–7. *Zygosporium verruciferum* (holotype, VEN 332005). 1. Conidiophores, vesicles, conidiogenous cells, and conidia. 2. Setiform conidiophore with vesicular conidiophore front view. 3–6. Vesicles and conidiogenous cells, vesicular conidiophore and conidia. 7. Conidiophore basal cell.

1971, McKenzie et al. 2007, Whitton et al. 2003). The new species produces conidia similar to *Z. oscheoides* Mont. (the generic type), which differs by its larger, ornamented conidia (8–13.5 × 6–8 µm) and its longer, narrower vesicular conidiophores (<18 × 7–9 µm; Hughes 1951, Whitton et al. 2003). Table 1 compares *Z. verruciferum* morphologically with *Z bioblitzi, Z. geminatum, Z. oscheoides,* and *Z. pacificum*.

Acknowledgments

We are very grateful to Dr. R.F. Castañeda-Ruíz, Dr. Eric H.C. McKenzie, and Dr. Shaun Pennycook for critically reviewing the manuscript and providing helpful

Table 1. *Zygosporium* species with ellipsoid conidia, two conidiogenous cells per vesicular conidiophore, and setiform conidiophores

Species	Conidia		Setae (from conidiophores: SC)		Vesicular conidiophores (VC)		Hyphal cell wall
	Morphology	Size (µm)	Morphology	Size (µm)	Morphology	Size (µm)	
Z. bioblitzi	Covered by brown, raised, flattened ornamentation; base truncate, protruding, cylindrical; brown	14–21 × 7.5–11	Brown; apical cell paler, obtuse	40–75 × 2–3	Brown; 1 per SC	8–10.5 × 7.5–11	Brown to hyaline; smooth
Z. geminatum	Tuberculate, verrucose, raised areas flattened; pale brown to brown	20–30 × 8–11	Dark brown; apex hyaline, clavate, sparsely echinulate, usually ending in a hyaline knob	65–110 × 3.5–5	Dark brown; arising from SC, 1 per SC	12–15 × 6–8	Brown to hyaline; smooth
Z. oscheoides	Smooth to minutely verruculose; hyaline to pale brown	8–13.5 × 6–8	Dark brown below; apex hyaline, clavate, smooth	30–60 × 3–4	Dark brown; arising from SC, 1 per SC	9–18 × 7–9	Brown to hyaline; smooth
Z. pacificum	Coarsely verrucose, with raised and flattened areas; pale brown	11–16 × 6.5–7.5	Dark brown below; apex hyaline, clavate, smooth	53–61 × 3.5–5	Dark brown; arising from SC, 1 per SC	19–28 × 8–12.5	Brown to hyaline; smooth
Z. verruciferum	Smooth; hyaline to subhyaline	5 × 4–5	Brown; apex hyaline to subhyaline, attenuate, clavate	42–57 × (2.4–)3.6–5	Brown to darkish brown; 1 per SC	9.6–12 × 9.6–11	Brown to hyaline; verrucose

suggestions to improve this paper. We are also grateful to Edmundo Guerrero, Alexis Vera, Livia Santana, Jay McGowan, Bruno Manara, José Ramón Grande, Finca Frutiagro PTM C.A. and Vector Biology Laboratory – UCV.

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Diaporthe camptothecicola sp. nov. on *Camptotheca acuminata* in China

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Abstract—A novel species *Diaporthe camptothecicola* is described and illustrated from cankers on branches of *Camptotheca acuminata* (*Cornaceae*) collected at Nanjing Agricultural University, Jiangsu Province, China. Recognition of this new species is supported by both morphology and phylogeny. The alpha conidia are hyaline, aseptate, oblong (6.2 × 1.6 µm), and inconspicuously biguttulate, similar to most species of *Diaporthe*. The beta conidia are hyaline, aseptate, filiform to hamate, 25.1 × 1.0 µm. Multi-locus phylogenetic analysis based on ITS, CAL, HIS, TEF1-α, and TUB2 gene regions suggests the new species belongs to *Diaporthe*.

Key words—ascomycete, *Diaporthales*, dieback, systematics, taxonomy

Introduction

Members of *Diaporthe* are plant pathogens, endophytes, and saprobes with extensive host ranges and wide geographic distributions (Wehmeyer 1933; Uecker 1988; Crous & Groenwald 2005, Rossman et al. 2007; Udayanga et al. 2011, 2012a, b, 2014a, b, 2015; Huang et al. 2013, 2015; Gao et al. 2014, 2015, 2016; Fan et al. 2015; Du et al. 2016). This genus is characterized by ostiolate conidiomata with elongate, cylindrical phialides and may produce three types conidia, of which alpha and beta conidia are produced frequently (Udayanga et al. 2011). The sexual morph is characterized by immersed ascomata and

Table 1. *Diaporthe* isolates and sequences used in the phylogenetic analysis

Species	Isolate	Host	Location	GenBank accession numbers				
				ITS	CAL	HIS	TEF1-α	TUB2
D. alleghaniensis	CBS 495.72^{T}	*Betula alleghaniensis*	Canada	KC343007	KC343249	KC343491	KC343733	KC343975
D. alnea	CBS 146.46^{T}	*Alnus* sp.	Netherlands	KC343008	KC343250	KC343492	KC343734	KC343976
	CBS 159.47	*Alnus* sp.	Netherlands	KC343009	KC343251	KC343493	KC343735	KC343977
	LCM22b.02a	*Alnus* sp.	USA	KJ210535	KJ435020	KJ420883	KJ210557	KJ420825
	LCM22b.02b	*Alnus* sp.	USA	KJ210536	KJ435021	KJ420884	KJ210558	KJ420826
D. apiculata	LC3418^{T}	*Camellia sinensis*	China	KP267896	—	—	KP267970	KP293476
D. bicincta	CBS 121004^{T}	*Juglans* sp.	USA	KC343134	KC343376	KC343618	KC343860	KC344102
D. biguttusis	CGMCC 3.17081^{T}	*Lithocarpus glaber*	China	KF576282	—	—	KF576257	KF576306
	CGMCC 3.17082	*Lithocarpus glaber*	China	KF576283	—	—	KF576258	KF576307
D. camptothecicola	**CFCC 51632^{T}**	***Camptotheca acuminata***	**China**	**KY203726**	**KY228877**	**KY228881**	**KY228887**	**KY228893**
	CFCC 51633	***Camptotheca acuminata***	**China**	**KY203727**	**KY228878**	**KY228882**	**KY228888**	**KY228894**
D. celastrina	CBS 139.27^{T}	*Celastrus* sp.	USA	KC343047	KC343289	KC343531	KC343773	KC344015
D. citrichinensis	ZJUD 34A^{T}	*Citrus* sp.	China	JQ954648	KC357494	—	JQ954666	—
	ZJUD 34B	*Citrus* sp.	China	JQ954649	KC357495	—	JQ954667	KC357461
D. ellipicola	CGMCC 3.17084^{T}	*Lithocarpus glaber*	China	KF576270	—	—	KF576245	KF576291
	CGMCC 3.17085	*Lithocarpus glaber*	China	KF576271	—	—	KF576246	KF576292
D. eres	AR5193^{T}	*Ulmus* sp.	Germany	KJ210529	KJ434999	KJ420850	KJ210550	KJ420799
	FAU483	*Malus* sp.	Netherlands	KJ210537	KJ435022	JQ807422	KJ420874	KJ420827
	DNA001A	*Daphne laureola*	France	KJ210516	KJ434994	KJ210540	KJ420831	KJ420781

D. eres [continued]	DNA001B	*Daphne laureola*	France	KJ210517	KJ434995	KJ210541	KJ420832	KJ420782
	AR3519	*Corylus avellana*	Austria	KJ210523	KJ435008	KJ210547	KJ420839	KJ420789
	AR3723	*Rubus fruticosus*	Austria	JQ807428	KJ435024	JQ807354	KJ420843	KJ420793
	AR3560	*Viburnum* sp.	Austria	KJ420795	KJ435011	JQ807351	KJ420846	KJ420795
	AR5223	*Acer negundo*	Germany	KJ210528	KJ435000	KJ210549	KJ420845	KJ420830
D. gardeniae	CBS 288.56	*Gardenia florida*	Italy	KC343113	KC343355	KC343597	KC343839	KC344081
D. helicis	AR5211^{T}	*Hedera helix*	France	KJ210538	KJ435043	KJ420875	KJ210559	KJ420828
D. longicicola	CGMCC 3.17089^{T}	*Lithocarpus glaber*	China	KF576267	—	—	KF576242	KF576291
	CGMCC 3.17090	*Lithocarpus glaber*	China	KF576268	—	—	KF576243	KF576292
D. mahothocarpi	CGMCC 3.15181^{T}	*Lithocarpus glaber*	China	KC153096	—	—	KC153087	KF576312
D. maritima	DAOMC 250563	*Picea rubens*	Canada	KU552025	—	—	KU552023	KU574615
D. neilliae	CBS 144.27^{T}	*Spiraea* sp.	USA	KC343144	KC343386	KC343628	KC343870	KC344112
D. nobilis	CBS 113470	*Castanea sativa*	Korea	KC343146	KC343388	KC343630	KC343872	KC344114
D. nomurai	CBS 157.29	*Morus* sp.	Japan	KC343154	KC343396	KC343638	KC343880	KC344122
D. oraccinii	LC3166^{T}	*Camellia sinensis*	China	KP267863	—	KP293517	KP267937	KP293443
D. penetritea	LC3353^{T}	*Camellia sinensis*	China	KP714505	—	KP714493	KP714517	KP714529
D. pulla	CBS 338.89^{T}	*Hedera helix*	Yugoslavia	KC343152	KC343394	KC343636	KC343878	KC344120
D. subclavata	ICMP 20663^{T}	*Citrus unshiu*	China	KJ490587	—	KJ490529	KJ490466	KJ490408
D. vaccinii	CBS 160.32^{T}	*Oxycoccus macrocarpos*	USA	KC343228	KC343470	KC343712	KC343954	KC344196
	DF5042	*Vaccinium corymbosum*	USA	AF317570	KC849457	KJ420877	JQ807380	KC843225
D. citri	AR3405^{T}	*Citrus* sp.	USA	KC843311	KC843157	KJ420881	KC843071	KC843187

New species are bold.

erumpent pseudostroma with more or less elongated perithecial necks; asci are unitunicate, clavate to clavate-cylindrical; and ascospores are biseriate to uniseriate in the ascus, septate, hyaline, and sometimes with appendages (Wehmeyer 1933, Muntañola-Cvetković et al. 1981).

During collecting trips in Jiangsu Province, China, fresh specimens were collected from symptomatic cankered branches of *Camptotheca acuminata*. A fungal specimen was found with characters fitting the genus *Diaporthe*. Because species of *Diaporthe* cannot easily be distinguished morphologically, a phylogenetic analysis were carried out based on ITS, CAL, HIS, TEF1-α, and TUB2 gene regions. This analysis determined that this species belongs in *Diaporthe* and is distinct from all other currently described and sequenced species in the *D. eres* species complex.

Materials & methods

Samples and isolates

The isolates were obtained from two specimens by single spore isolation following the methods of Fan et al. (2014). Single germinating conidia were removed and plated onto fresh PDA plates after incubation at 25 °C for up to 24 h. Specimens and isolates of the fungus are deposited in the Museum of Beijing Forestry University, Beijing, China (BJFC). Axenic cultures are maintained in the China Forestry Culture Collection Center, Beijing, China (CFCC).

Morphological studies

Observations of morphological features of the fruiting bodies produced on infected plant tissues were supplemented by cultural characteristics. Vertical and horizontal sections were cut through the fruiting bodies by hand using a double-edge blade. The morphology of the fruiting bodies including size of conidiomata and locules, size and shape of conidiophores and conidia was examined under a Leica DM 2500 compound microscope. More than 20 fruiting bodies were sectioned, and 50 spores were selected randomly for measurement using a Leica LM/DM 2500 compound microscope. Cultural characteristics (e.g., colony color, texture, arrangement of the conidiomata) of isolates incubated on PDA in the dark at 25 °C were observed and recorded at 3, 7, and 30 days.

DNA extraction, PCR amplification, and sequencing

Genomic DNA was extracted from colonies grown on PDA with cellophane using a modified CTAB method (Doyle & Doyle 1990). DNA were estimated by electrophoresis in 1% agarose gels, and the quality was measured by NanoDrop™ 2000 (Thermo, USA) according to the user's manual (Desjardins et al. 2009). The internal transcribed spacer (ITS) region was amplified with primers ITS1 and ITS4 (White et al. 1990); the CAL region with primers CAL-228F and CAL-737R (Carbone & Kohn 1999); the HIS region with primers CYLH4F (Crous et al. 2004) and H3-1b (Glass &

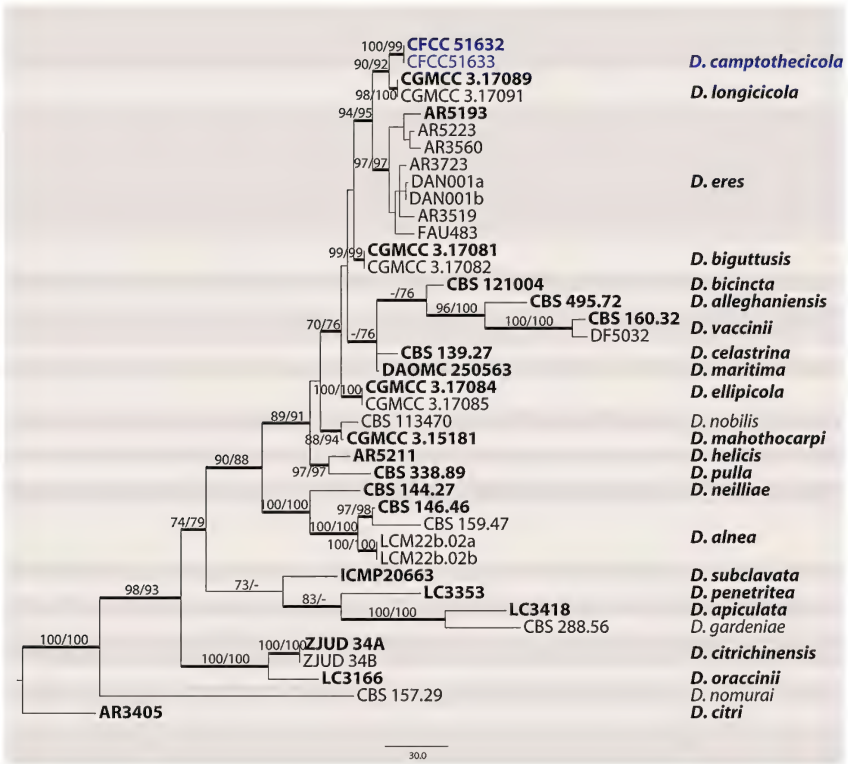

Plate 1. Phylogram of *Diaporthe* based on combined ITS, CAL, HIS, TEF1-α, and TUB2 dataset. MP and ML bootstrap support values above 70% are shown at the first and second position. Thickened branches represent posterior probabilities above 0.9 from BI. Scale bar = 30 nucleotide substitutions. Ex-type strains are in bold. Sequences generated in our study are in blue.

Donaldson 1995); the partial translation elongation factor 1-alpha (TEF1-α) region with primers EF-728F and EF-986R (Carbone & Kohn 1999); and the β-tubulin2 (TUB2) region with primers Bt2a & Bt2b (Glass & Donaldson 1995). The PCR amplification products were estimated visually by electrophoresis in 2% agarose gels. DNA sequencing was performed using an ABI PRISM® 3730XL DNA Analyzer with BigDye® Terminator Kit v.3.1 (Invitrogen) at the Shanghai Invitrogen Biological Technology Company Limited (Beijing, China).

DNA sequence analysis

The sequences of our isolates and the reference GenBank sequences (mostly those used by Udayanga et al. 2014b), are listed in Table 1; they were aligned using MAFFT v.6 (Katoh & Toh 2010) and edited manually using MEGA6 (Tamura et al. 2013). PAUP v.4.0b10 was used for maximum parsimony (MP) analysis (Swofford 2003); PhyML

v.7.2.8 for maximum likelihood (ML) analysis (Guindon et al. 2010); and MrBayes v.3.1.2 for Bayesian Inference (BI) (Ronquist & Huelsenbeck 2003). *Diaporthe citri* (AR3405) was selected as outgroup in this analysis (Udayanga et al. 2014b). Trees are shown using FigTree v.1.3.1 (Rambaut & Drummond 2010).

MP, ML, and BI analyses were applied to the combined ITS, CAL, HIS, TEF1-α, and TUB2 dataset. All characters were treated as unordered and equal weight. MP analysis was used, based on strict heuristic searches with a tree bisection and reconnection (TBR) algorithm. Maxtrees were set to 5000, branches of zero length were collapsed and all equally parsimonious trees were saved. Bootstrap values were calculated from 1000 replicates. Other calculated parsimony scores were tree length (TL), consistency index (CI), retention index (RI) and rescaled consistency (RC). ML analysis was also performed with a GTR site substitution model (Guindon et al. 2010). The branch support was evaluated with a bootstrapping (BS) method of 1000 replicates (Hillis & Bull 1993). BI analysis with Markov Chain Monte Carlo (MCMC) algorithm was performed (Rannala & Yang 1996). The models of evolution were estimated by MrModeltest v.2.3 (Posada & Crandall 1998). Sequences were deposited in GenBank (Table 1), and the multilocus sequence alignment file was deposited in TreeBASE (www.treebase.org) as accession S20509.

Results

Molecular phylogeny

The combined (ITS, CAL, HIS, TEF1-α, TUB2) alignments for phylogenetic analysis contained 40 taxa (including one outgroup), comprising 2554 characters after alignment. Of these, 1929 characters were constant, 293 variable characters were parsimony-uninformative, and 332 characters were parsimony informative. The MP analysis resulted in 4 equally most parsimonious trees, with the first tree (TL = 1074, CI = 0.692, RI = 0.764, RC = 0.528) was shown in Plate 1. The phylogenetic tree obtained from ML and Bayesian analyses with the MCMC algorithm was consistent with the previous MP tree. The branches with significant Bayesian posterior probability (≥ 0.70) in Bayesian analyses were thickened in the phylogenetic tree. Isolates in the current study clustered in a distinct clade with a high support (MP/ML/BI=100/99/1) (Plate 1). The sequences were determined to represent a new species as described in this paper.

Taxonomy

Diaporthe camptothecicola C.M. Tian & Qin Yang, **sp. nov.** Plate 2

MycoBank MB 822351

Differs from *Diaporthe longicicola* by its smaller alpha and beta conidia, and shorter conidiophores.

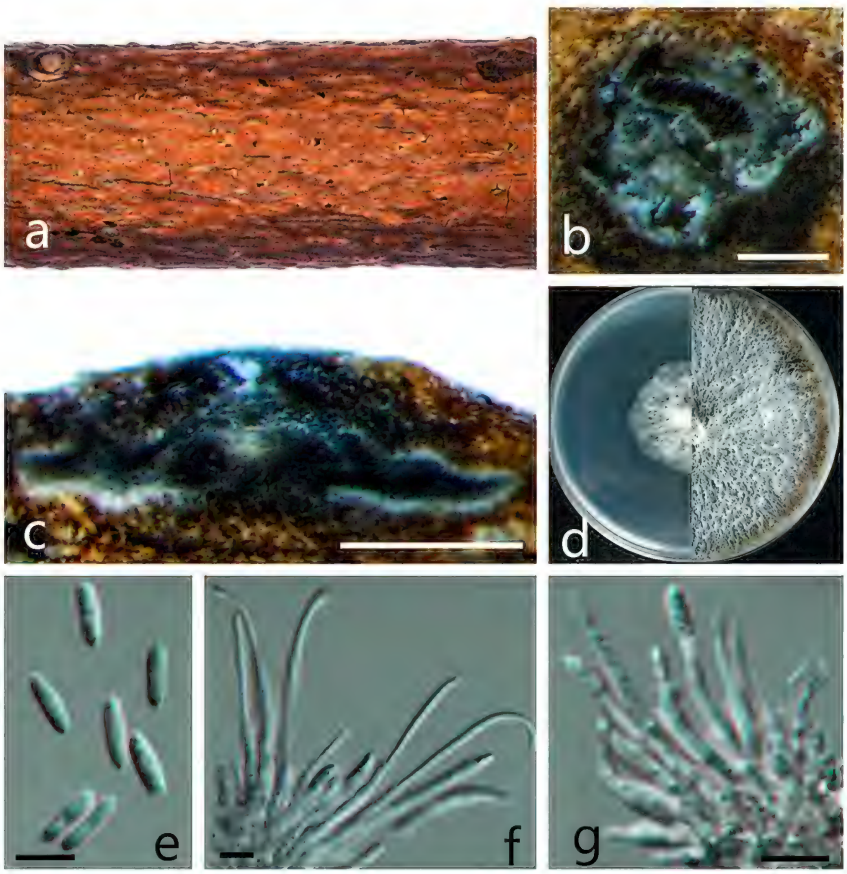

Plate 2. *Diaporthe camptothecicola* (holotype, BJFC-S1372) from *Camptotheca acuminata*. a: Habit of conidiomata on twig; b: Transverse sections through conidiomata; c: Longitudinal sections through conidiomata; d: Colonies on PDA at 3 days (left) and 30 days (right); e: Alpha conidia; f: Beta conidia; g: Conidiophores. Scale bars: b, c = 200 μm; e–g = 5 μm.

Type: China, Jiangsu Prov., Nanjing Agricultural University, 32°04′35″N 118°48′39″E, 9 m asl, on twigs and branches of *Camptotheca acuminata* Decne. (*Cornaceae*), 24 August 2014, coll. X.L. Fan (**Holotype,** BJFC-S1372; ex-type culture CFCC 51632).

Etymology: *camptothecicola* (Lat.), named after the host genus, *Camptotheca.*

Conidiomatal pycnidia immersed in bark, slightly erumpent through bark surface, sparse, globose to ovoid. Locule undivided, circular to ovoid, sometimes irregular, (450–)545–580(–600) μm diam. (av. = 560 μm, n = 20). Conidiophores (8.3–)12.5–15.8(–17.0) × 0.9–1.2 μm (av. = 13.2 × 1.1 μm, n = 50),

hyaline, unbranched, smooth, cylindrical, straight or slightly curved. Conidiogenous cells enteroblastic, phialidic. Alpha conidia hyaline, aseptate, oblong, inconspicuously biguttulate, (4.6–)5.5–7.0(–7.5) × 1.5–1.8 µm (av. = 6.2 × 1.6 µm, n = 50), more frequent than beta conidia. Beta conidia hyaline, aseptate, filiform or hamate with obtuse ends, (19.5–)23.3–27.5(–28.3) × 1.0 µm (av. = 25.1 × 1.0 µm, n = 50). Culture on PDA at first white, becoming grayish. Aerial mycelium white, cottony, with sparse, yellowish-brown and irregular margin, producing black pigment. Sexual morph not observed.

Host/Distribution: on branches of *Camptotheca acuminata* in China.

Additional specimen examined: **China, Jiangsu Prov.**, Nanjing Agricultural University, 32°04′35″N 118°48′39″E, 9 m asl, on twigs and branches of *Camptotheca acuminata*, 24 August 2014, coll. X.L. Fan (BJFC-S1373; living culture CFCC 51633).

Note: Two strains representing *D. camptothecicola* clustered in a well-supported clade, a species supported as distinct by molecular data. The most closely related species in the phylogram is *D. longicicola* Y.H. Gao & L. Cai. *Diaporthe longicicola* differs from *D. camptothecicola* by its larger alpha conidia (7.4 × 2.2 µm), its larger beta conidia (25–32.2 × 1.2–2 µm), and its longer conidiophores (14.1–22.5 µm; Gao et al. 2015).

Discussion

Phylogenetic analysis clustered the NAU collection within *Diaporthe* and closely related to *D. longicicola*. Both morphology and rDNA data support the Nanjing collection as a new species in the genus *Diaporthe*. Multi-locus gene regions were effectively used to identify *Diaporthe* species in this study as in many contemporary studies (Baumgartner et al. 2013; Huang et al. 2013; Tan et al. 2013; Dissanayake et al. 2015; Fan et al. 2015; Udayanga et al. 2014a, b, 2015; Gao et al. 2016).

Species recognition criteria in *Diaporthe* have historically been based on morphology and host affiliation. This has caused confused species delimitation (Aa et al. 1990, Rehner & Uecker 1994, Mostert et al. 2001, Santos & Phillips 2009, Udayanga et al. 2012a). A *Diaporthe* species previously reported on this host, *Phomopsis camptothecae* C.Q. Chang et al., was determined to be a synonym of *Diaporthe sojae* Lehman (Udayanga et al. 2015). *Diaporthe camptothecicola* can be distinguished by its conidiophores and alpha conidia; *D. sojae* has wider alpha conidia (5.3–7.3 × 2–3 µm) and wider conidiophores (2–4 µm; Udayanga et al. 2015). Phylogenetic analysis based on multi-locus (ITS, CAL, HIS, TEF1-α, and TUB2) demonstrated the distinctive new species in *Diaporthe* with highly supported clades (MP/ML/BI = 100/100/1).

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New species of *Cephalotrichum*, *Leptographium*, and *Myrothecium* from soil in China

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Abstract—Three new species isolated from soil in China—*Cephalotrichum turriforme*, *Leptographium lateritium*, and *Myrothecium curvisporum*—are described, illustrated, and compared morphologically with similar species. The type specimens (dried cultures) and living cultures are deposited in the Herbarium of Shandong Agricultural University: Plant Pathology (HSAUP).

Key words—asexual fungi, dematiaceous hyphomycetes, taxonomy

Introduction

Cephalotrichum was established by Link (1809) with *C. stemonitis* as type species. This genus produces its spores in a dry head at the apex of a complex erect conidiophore or synnema, which is often up to a millimeter in height. The synnemata produce chains of powdery conidia with a 'bottle brush' or 'feather' appearance. The ovoid conidia are produced from penicillately arranged, annellidic conidiogenous cells covering the sporogenous area (Chlebicki 2008).

Leptographium, established by Lagerberg & Melin (Lagerberg et al. 1927) with *L. lundbergii* Lagerb. & Melin as type species, is characterized by dark, macronematous, mononematous, penicillately-branched conidiophores that

§ Y.L. Jiang and Y.M. Wu contributed equally to this work.

produce annellidically (or both annellidically and sympodially) proliferating conidiogenous cells with hyaline, aseptate conidia produced in a slimy matrix (Hughes 1953; Kendrick, 1961, 1962, 1980; Wingfield 1985).

Myrothecium, founded by Tode (1790) and sanctioned (in an emended form) by Fries (1829), was typified by *M. inundatum* Tode. Historically, the genus has been characterized by sporodochia that are shallow cups covered with a viscid spore-mass at first green, becoming jet black, with a white margin of flocculent contorted hyphae, with or without setae; conidiophores that are septate, hyaline or olivaceous, consisting of a main axis which is once or twice branched, with the branches apical and arranged penicillately; phialides that are narrowly clavate, hyaline or pale olive green; and conidia that are small, cylindrical, or elliptical with a truncate base, often guttulate, continuous, subhyaline or pale olive green, abstricted singly to form a black viscid mass (Ellis 1971, Tulloch 1972). However, as outlined by Schroers et al. (1999) and Seifert et al. (2011), a distinction is now made between *Myrothecium* sensu stricto (of uncertain family affinity, and without authenticated teleomorphs) and "*Myrothecium*-like" anamorphs (with teleomorph connections in *Nectriaceae* and *Bionectriaceae*).

During a survey on soil dematiaceous hyphomycetes in China, we obtained three fungi that grew on potato dextrose agar (PDA) and exhibited the morphological characters typical of *Cephalotrichum*, *Leptographium*, and *Myrothecium*. They did not match with any congeneric species and are therefore proposed as new taxa.

Cephalotrichum turriforme T.Y. Zhang, Y.L. Jiang & Y.M. Wu, **sp. nov.** Fig. 1

MycoBank MB 820187

Differs from *Cephalotrichum microsporum* by its larger conidia, from *C. ovoideum* by its unbranched synnemata with tower-shaped heads, and from *C. stemonitis* by its shorter annellophores and narrower conidia.

Type: China, Hubei Province, Fangxian County, from a farmland soil, 15 October 2004, Y.L. Jiang (**Holotype**, HSAUP II_{05}0539).

Etymology: in reference to the tower-shaped heads of the synnemata.

Colonies on PDA effuse, blackish brown. Mycelium partly superficial, partly immersed; hyphae hyaline, branched, septate, smooth, 1–3.5 µm diam. Synnemata 500–800 µm high, unbranched, with sharp turriform heads. Annellophores ampuliform, brown, penicillately arranged, 8–11 µm long, with swollen base 2–3.5 µm diam., narrowing abruptly into the annellated region 1.5–2 µm diam. Conidia solitary or catenate, ovoid to broadly ovoid, aseptate, smooth, truncate at the base and pointed at the apex, 5–8 × 3.5–4 µm, brown, dark brown to black in mass.

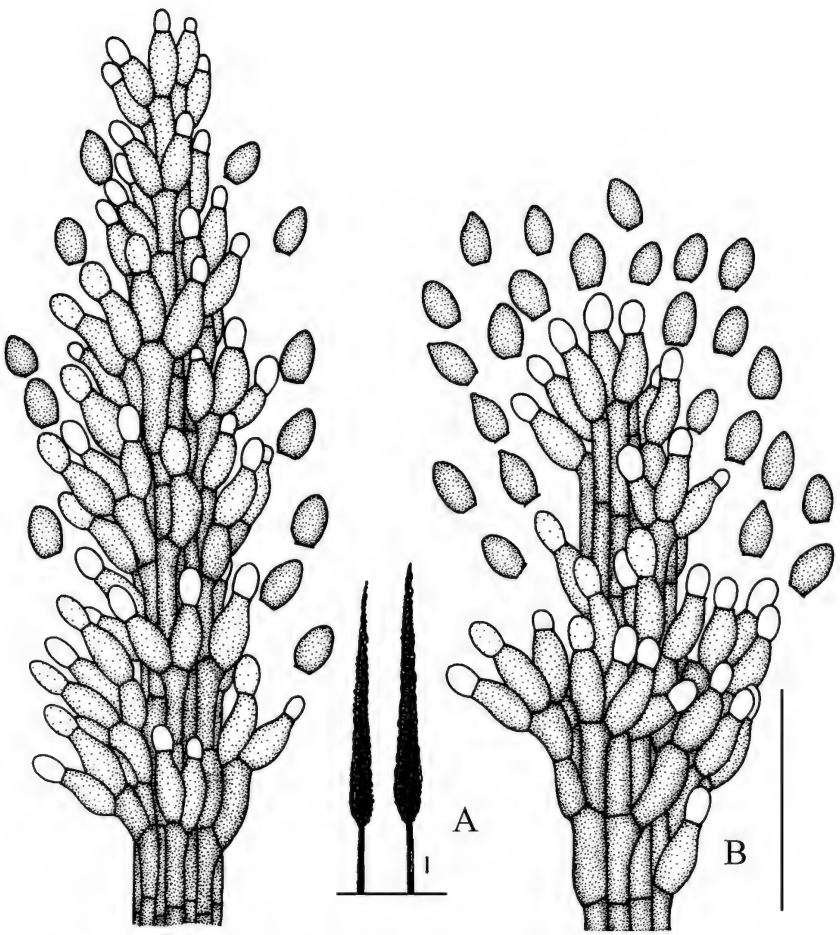

Fig. 1. *Cephalotrichum turriforme* (ex holotype HSAUP II_{05}0539).
Conidia, synnemata, conidiophores, and annellophores. Scale bars: A = 100 μm, B = 25 μm.

Comments: In conidial morphology, *Cephalotrichum turriforme* is close to *C. microsporum* (Sacc.) P.M. Kirk, *C. ovoideum* Y.L. Jiang & T.Y. Zhang, and *C. stemonitis* (Pers.) Nees; however, *C. microsporum* differs by its much smaller conidia (3–5 × 2–3 μm) with rounded or pointed apices (Kirk & Spooner 1984); *C. ovoideum* differs by its branched synnemata with spherical or subspherical heads and pale yellowish brown to yellowish brown conidia (Jiang et al. 2011); and *C. stemonitis* differs by its longer annellophores (8–25 μm) and bigger conidia (6–8.5 × 4–4.5 μm; Morton & Smith 1963).

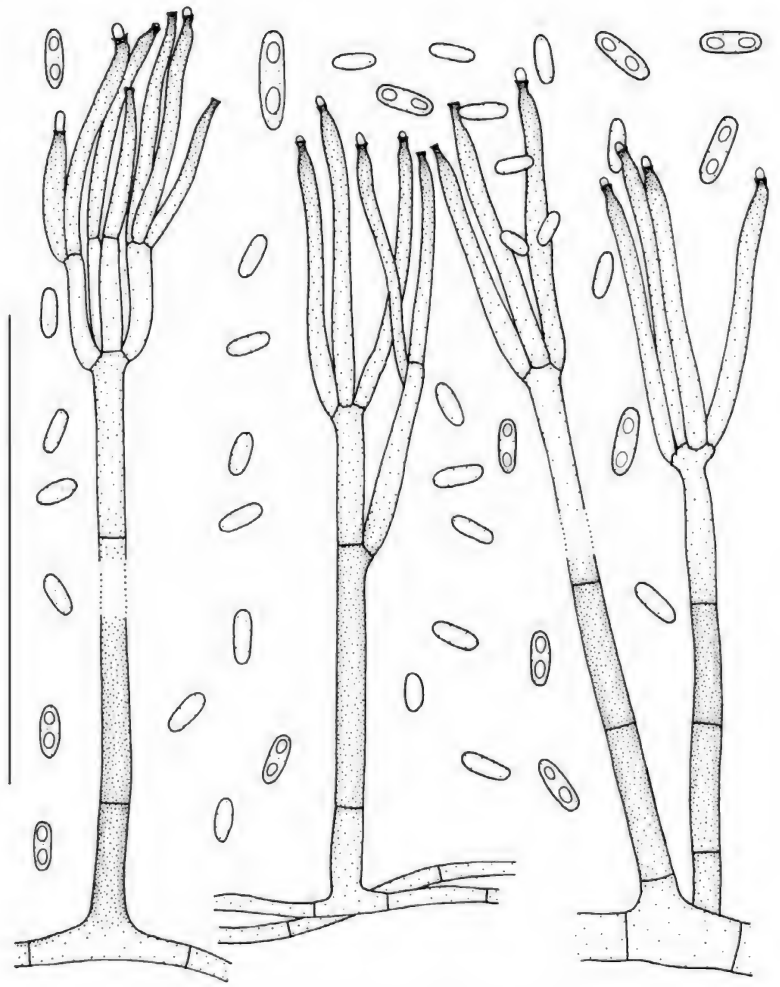

FIG. 2. *Leptographium lateritium* (ex holotype HSAUP $II_{04}2816$).
Conidia, conidiophores, conidiogenous apparatus, and annellation. Scale bar = 50 μm.

Leptographium lateritium J.J. Xu & T.Y. Zhang, **sp. nov.** FIG. 2

MYCOBANK MB 818979

Differs from *Leptographium terebrantis* by its brick red or reddish brown colored colonies and smaller conidia with rounded ends.

TYPE: China, Fujian Province, Longyan City, from a park soil, 12 September 2004, J.J. Xu (**Holotype**, HSAUP $II_{04}2816$).

ETYMOLOGY: in reference to the brick-red colony.

Colonies on PDA effuse, velvety or cottony, loose, brick-red or reddish brown, reverse the same in color, growing moderately fast, reaching 5–8 cm diam. in 2 weeks at 25 °C. Mycelium mostly superficial; hyphae sometimes aggregate forming ropes, pale to mid brown, branched, septate, smooth, 2–9 µm wide. Conidiophores arise on aerial hyphae or mycelial ropes, lateral, single or sometimes in groups, macronematous, mononematous, septate, stipe erect or suberect, pale brown to brown, becoming lighter in color at the apex, ≤325 µm long, 2.5–3.5 µm diam. and slightly swollen at the apex; conidiogenous apparatus consisting of no more than two series of branches, primary branches 2–5 on stipe, 10–30 × 2–3 µm, secondary branches 9–32 × 2–3 µm. Conidiogenous cells discrete, arranged penicillately, cylindrical, subhyaline to pale brown, smooth, tapering from base to apex, annellidic region dark brown to blackish brown, 9–35 × 2–3 µm. Conidia accumulating in slimy heads, ellipsoidal, cylindrical to oblong, hyaline to pale brown, smooth, aseptate, rounded at both ends, sometimes 1–2-guttulate, 3–10 × 1.5–2 µm.

Comments: In conidial morphology, *Leptographium lateritium* resembles *L. terebrantis* S.J. Barras & T.J. Perry, which differs by its olivaceous black, yellowish olive, dark green olive to olive colonies, and its bigger conidia (2.4–12.8 × 1.2–3.7 µm; x = 7.4 × 2.5 µm, and a length often increasing up to 25–30 µm) with truncate ends (Barras & Perry 1971).

Myrothecium curvisporum Y.L. Zhang & T.Y. Zhang, **sp. nov.** Fig. 3

MycoBank MB 818980

Differs from all other *Myrothecium* species by its lunate conidia.

Type: China, Hainan Province, Mt. Wuzhishan, from a montane soil, 16 November 2005, Y.L. Zhang (**Holotype**, HSAUP II_{05}2312).

Etymology: in reference to the sharply curved conidia.

Colonies on PDA effuse, loosely flocculent, white, reverse pale brown or greyish white, growing rapidly attaining a diameter of 5 to 7 cm in 2 weeks at 25 °C. Sporodochia stalked, no more than 1 mm diam., often confluent within larger masses; green at first, later becoming black with white floccose margin. Mycelium superficial and immersed; hyphae hyaline, smooth, branched, septate, 2–3 µm wide. Conidiophores hyaline to pale brown, smooth, with apical branches arranged penicillately. Phialides slenderly subulate, 30–50 × 0.5–1.3 µm. Conidia aseptate, often curved, lunate, generally biguttulate, 4–6 × 1.5–2 µm, accumulating in dark green to black, viscid mass.

Comments: Under the label "*Myrothecium* state of *Nectria bactridioides* Berk. & Broome", Ellis (1971) and Tulloch (1972) described an anamorph on *Theobroma*

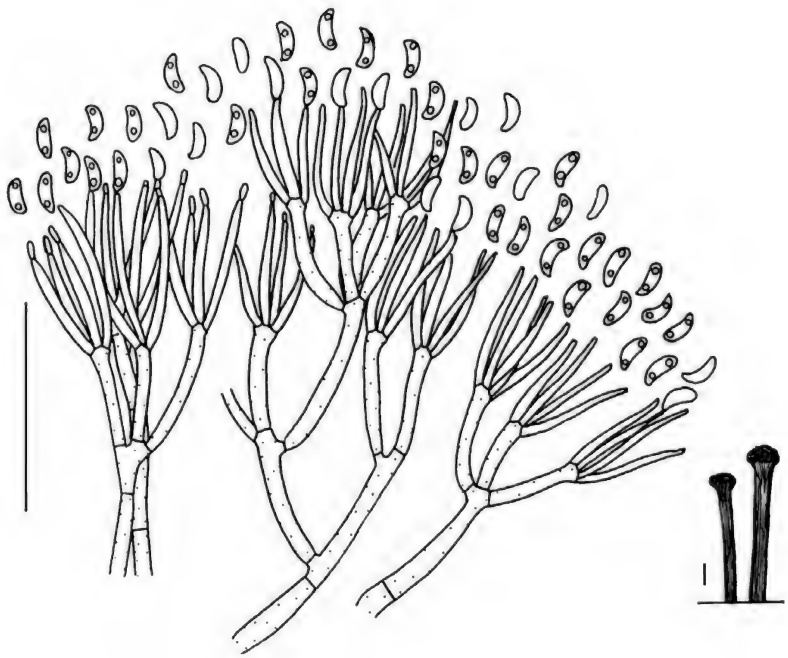

FIG. 3. *Myrothecium curvisporum* (ex holotype HSAUP II_{05}2312). Conidia, sporodochia, conidiophores, and phialides. Scale bars = 25 μm.

in Sri Lanka. However, Samuels (1988) described *Nectria bactridioides* [≡ *Nectriopsis bactrydioides* (Berk. & Broome) Samuels] as a mycoparasite with no known anamorph, and identified one of its substrates as the anamorphic state of the lignicolous species *Nectria pityrodes* (Mont.) Mont. [≡ *Bionectria pityrodes* (Mont.) Schroers]. This anamorph was described as "*Myrothecium*-like" (Schroers et al. 1999), and subsequently named as *Clonostachys pityrodes* Schroers, which differs from *M. curvisporum* [and also from the "*Myrothecium* state of *Nectria bactridioides*"] by its non-stipitate, flat to cupulate sporodochia and its larger, symmetrical, oval conidia (5.8–7.2 × 2.8–3.4 μm; Schroers 2001). The "*Myrothecium* state of *Nectria bactridioides* has stipitate or synnematous sporodochia and smaller, asymmetrical, ellipsoid or allantoid conidia with rounded ends (Ellis 1971, Tulloch 1972); these sporodochial characters and the conidial size are similar to those of *M. curvispora*, which differs by most of its conidia being lunate, with acute ends and a greater degree of curvature. We conclude that *M. curvisporum* differs from all described *Myrothecium*-like species, both named and unnamed.

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First record of bioluminescence in fungi from Mexico

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Abstract—Two species of bioluminescent fungi are recorded from Mexico. *Mycena stylobates* is characterized by a pubescent basal disc, pileus with a separable gelatinous pellicle, and cheilocystidia with coarse excrescences, and represents a new record for the country. *Panellus stipticus,* which is distinguished by having rounded flabelliform basidiomata and allantoid to elongate basidiospores, has been previously recorded from Mexico but without any observation of bioluminescence. The specimens were collected in relict cloud forests from the state of Veracruz, Mexico.

Key words—*Agaricales*, biodiversity, *Mycenaceae*, mycobiota, taxonomy

Introduction

Fungal bioluminescence results from a chemical reaction between a protein generically known as luciferin and an enzyme generically known as luciferase that produces emission of green light with a wavelength of 520–530 nm. Light can be emitted from the mycelium, or basidiome, or both (Desjardin et al. 2008, Shih et al. 2014, Chew et al. 2015). More than 80 macromycete species (all in *Basidiomycota*) have been recorded as bioluminescent. They are distributed in *Armillaria* (Fr.) Staude, *Favolaschia* (Pat.) Pat., *Filoboletus* Henn., *Gerronema* Singer, *Mycena* (Pers.) Roussel, *Neonothopanus* R.H. Petersen & Krisai, *Omphalotus* Fayod, *Panellus* P. Karst., *Poromycena* Overeem, and *Roridomyces* Rexer (Desjardin et al. 2008, Chew et al. 2015).

DNA based sequence analyses (Desjardin et al. 2008, Chew et al. 2015) group these genera in three lineages: 1) *Armillaria*, 2) mycenoid, and 3) *Omphalotus*. Bioluminescent macromycetes are found in tropical and temperate forests, and most of the species are saprobes that grow in high-moisture substrates such as decomposing trunks, roots, leaf-litter, and living tree bark. These fungi have been recorded from Brazil, Costa Rica, United States, Thailand, and numerous other countries (Corner 1950, 1954; Deheyn & Latz 2007; Desjardin et al. 2010; Chew et al. 2015; Seas-Carvajal & Avalos 2013). In Mexico, although genera such as *Mycena*, *Armillaria*, and *Panellus* have been recorded in taxonomic works or fungal lists (mainly from cloud forests; Chacón & Medel 1993), little attention has been given to bioluminescence. The aim of this work is to contribute to the knowledge of the biodiversity of bioluminescent macromycetes from Mexico.

Materials & methods

All specimens studied were collected in cloud forests and are deposited in the Mycological collection of the herbarium of Instituto de Ecología, Xalapa, Veracruz, Mexico (XAL). For the identification of macroscopic fungi, we followed Largent et al. (1977) and used the terminology for microstructures according to Vellinga (1988). For the microscopic analysis hand-made sections were made from different parts of dry basidiomata previously rehydrated in 70% ethyl alcohol, then mounted in a 5% solution of KOH, Melzer´s solution, or Congo red. At least 30 measurements were recorded for each taxonomically informative structure. Basidiospore shape was determined according to the Q quotient (length/width ratio). Basidiospores, cystidia, and other important microscopic structures were drawn using a drawing tube mounted on a Leica DME light microscope. All measurements represent the minimum and maximum dimensions observed, and measurements in parentheses represent dimensions that are considered outside the normal range. Photographs recording the bioluminescence in complete darkness were taken for *Mycena stylobates* with a Nikon D810 camera with a 105 mm macro lens (340 seconds exposure, ISO 6400, f/5.6 and f/6.3) and for *Panellus stipticus* with a Nikon D3200 camera with a 18-55 mm lens (60 seconds exposure, ISO 800, f/3.5).

Taxonomy

Mycena stylobates (Pers.) P. Kumm., Führ. Pilzk.: 108 (1871). PLATES 1A-C; 2A-I

PILEUS 3–13 mm diam, broadly parabolic, obtusely conical or hemispherical to convex or plano-convex, sometimes centrally depressed in older basidiomata; surface moist, subviscid, minutely squarrose, glabrous, translucent-striate to sulcate, pale brown at first to pale grey-brown with a whitish margin, or greyish white. CONTEXT thin, whitish. LAMELLAE adnexed, narrowly adnate, sometimes forming a pseudocollarium, white, close (14–18) with 2 series of lamellulae,

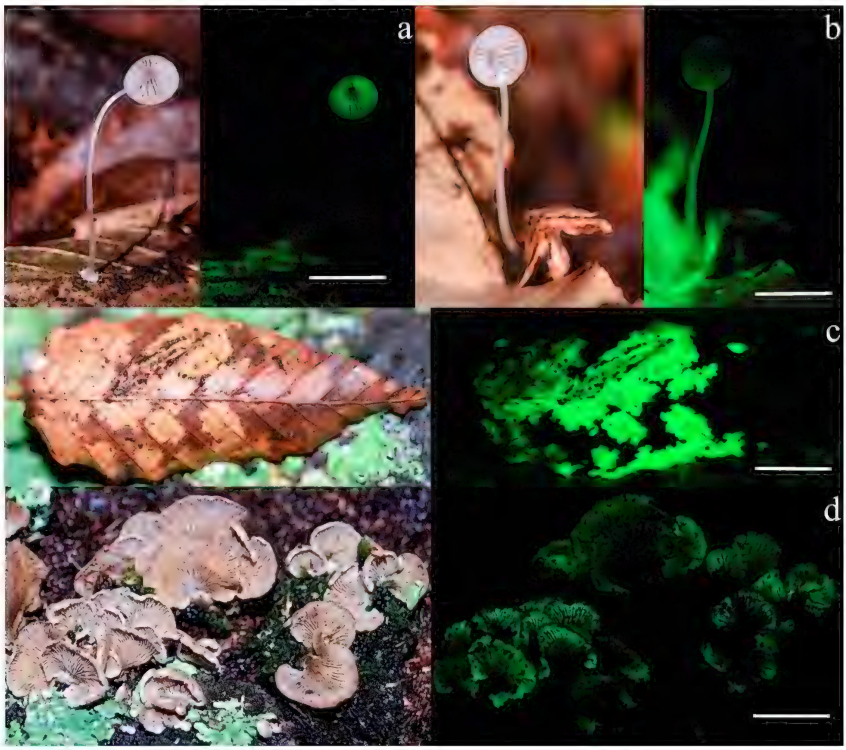

Plate 1. Bioluminescent Mexican basidiomes (paired light and dark exposures). ***Mycena stylobates*** (A = A. Cortés-Pérez & A. Rockefeller 1344; B, C = A. Cortés-Pérez & A. Rockefeller 1810). ***Panellus stipticus*** (D = A. Cortés-Pérez 1452). Scale bars = 10 mm.

edges even. Stipe 15–30 × 1–2 mm, central, equal, cylindrical, hollow, dry, pubescent, especially towards the apex, whitish and greyish white towards the base, emerging from a pubescent, sulcate, whitish basal disc. Basidiospores (6–)6.5–9 × 3–4.4(–4.8) µm (Q = 1.7–2.4), ellipsoid to oblong, smooth, hyaline, amyloid, thin-walled. Basidia 19–24 × 6–8 µm, clavate, 4-spored, hyaline, inamyloid. Cheilocystidia (20–)23–43(–50) × (6–)7–11(–13) µm, fusoid, clavate or cylindrical with one or several coarse excrescences with rounded apices, hyaline, inamyloid, forming a sterile lamellar edge. Pleurocystidia absent. Subhymenium cellular to inflated-ramose, hyphae 1.5–5 µm diam, hyaline, inamyloid. Lamellar trama regular, hyphae 1.5–21 µm diam, cylindrical, hyaline, dextrinoid. Pileipellis an ixocutis >60 µm thick, hyphae, 2–6 µm diam, the uppermost hyphae of the pileipellis covered with numerous,

cylindrical diverticula, around 2–8 × 0.5-1.5 µm. The lowermost hyphae of the separable pileipellis are smooth, cylindrical, hyaline, inamyloid. Pileus trama, hyphae 2–27 µm diam, inflated or cylindrical, hyaline, dextrinoid. Caulocystidia 34–82.5(–112) × 3–6.5(–8) µm, cylindrical with narrower rounded apices, in fascicles, hyaline, inamyloid. Basal disc cystidia 49–128 × 3–6(–8) µm, cylindrical with narrower rounded apex, hyaline, inamyloid. Clamp connections present.

Bioluminescence—Mycelium and occasionally in the pileus, or (rarely) in the entire basidiome.

Ecology & distribution—Solitary to scattered on leaf litter of *Fagus grandifolia* var. *mexicana* (Martínez) Little or *Quercus* spp. and on decaying twigs of ferns, in cloud forests between 1500–1900 m a.s.l.

Material studied—**MEXICO: Veracruz, Municipality of Acajete**, Mesa de la Yerba, 27 September 2014, leg. A. Cortés-Pérez 1205; 3 October 2014, leg. A. Cortés-Pérez 1214; 24 October 2014, leg. A. Cortés-Pérez 1223; 14 November 2014, leg. A. Cortés-Pérez 1244; 3 July 2015; leg. A. Cortés-Pérez & A. Rockefeller 1344; 18 September 2015, leg. A. Cortés-Pérez 1406; 27 September 2015, leg. A. Cortés-Pérez 1417; 20 August 2016, leg. A. Cortés-Pérez 1631; 2 September 2016, leg. A. Cortés-Pérez 1675; October 10, 2016, leg. A. Cortés-Pérez & A. Rockefeller 1810; **Municipality of Tlalnelhuayocan**, Los Capulines, 22 November 2014, leg. A. Cortés-Pérez 1254.

Comments—*Mycena stylobates* (*M.* sec. *Basipedes*) is characterized by a pileus with a separable gelatinous pellicle, claviform cheilocystidia with coarse excrescences, and a pubescent basal disc (Aronsen 2016). According to Aronsen (2016), *M. tenuispinosa* J. Favre is the most macroscopically similar species due to its pileus covered with small spinules; however the presence of cheilocystidia with thin excrescences separates the two species; Aronsen (2016) also cites *M. mucor* (Batsch) Quél. as similar, but its cheilocystidia with very thin excrescences and its non-pubescent basal disc distinguish it from our specimens. Our collections also agree with Pegler (1986), who described *M. stylobates* with basidiospores 7–10 × 2.7–4.5 µm (Q = 2.1) and cheilocystidia 20–42 × 7–13 µm, clavate, inflated, and with few to several apical protuberances. They also match Breitenbach & Kränzlin (1991), who described *M. stylobates* with basidiospores 7.2–10.8 × 3.5–4.8 µm (Q = 1.8–2.5) and cheilocystidia 28–40 × 5–11 µm, cylindrical to claviform, and with apical protuberances.

Mycena stylobates has been recorded in North America, South America, Europe, Asia, and Africa (Smith 1947, Walther et al. 2001, Desjardin et al. 2008, Franco-Molano et al. 2010, Shih et al. 2014). Desjardin et al. (2008) mentioned that the bioluminescence of *M. stylobates* is noticeable only in the mycelium; however, the observations of our studied material have shown

that the luminescent trait is also occasionally present in the pileus or in all of the basidiome, although the pileus or basidiome glows only slightly and this feature is variable among the basidiomes of distinct populations and occasionally within the same population. Desjardin et al. (2010) and Alves & Nascimento (2014) observed the same variability for *M. margarita* (Murrill) Murrill, in which some populations present bioluminescence and others lack this character.

Panellus stipticus (Bull.) P. Karst.,
Bidrag Kännedom Finlands Natur Folk 32: 96 (1879). PLATES 1D; 2J-Q

PILEUS 2–18 mm diam, rounded flabelliform to reniform, broadly convex, with an involute or inflexed margin that is crenulate or lobed; surface dull, dry, furfuraceous or appressed-squamulose, yellowish brown to yellowish white. CONTEXT thin, yellowish white; odor farinaceous. LAMELLAE decurrent, sometimes intervenose, narrowly ventricose, 0.8–1 mm broad, yellowish white, edge even, pale, crowded (16–24) with 3 series of lamellulae; edges even or fimbriate. STIPE lateral, sometimes very small or absent, 1–3 × 1–2 mm, cylindrical, narrower towards the base, solid, pubescent to tomentose, whitish. BASIDIOSPORES 3.5–5 × 2–2.5(–3) µm, (Q = 1.6–2.2), elongate, amyloid, hyaline. BASIDIA 11–18 × 3.5–5 µm, clavate or cylindrical, 2- and 4-spored with sterigmata 2–5 µm long, hyaline, inamyloid. CHEILOCYSTIDIA 22–60 × 4–7 µm, cylindrical or clavate, some rostrate or with irregular branches, hyaline, inamyloid. PLEUROCYSTIDIA absent or when the lamellae are intervenose present, 25–43 × 3–5 µm, cylindrical, some rostrate, in fascicles, hyaline, inamyloid. SUBHYMENIUM ramose to subcellular, hyaline, inamyloid. LAMELLAR TRAMA hyphae 1.5–7 µm diam, wall 0.5–3 µm thick, hyaline, inamyloid. PILEIPELLIS a cutis with hyphae 2–5 µm diam, thin or thick walled 0.5–1 µm, hyaline, inamyloid. PILEUS TRAMA hyphae 1.5–6 µm diam, thin or thick walls 0.5–3 µm, hyaline, inamyloid. STIPITIPELLIS hyphae 2–5 µm diam, smooth, thin walled, medullary hyphae, 2–7 µm diam, thin or thick walls 0.5–3 µm, cylindrical, smooth, hyaline, dextrinoid. CAULOCYSTIDIA or terminal hyphae, 25–55 × 3–5 µm, cylindrical with an acute apex, thick walled (0.8–1) µm, hyaline, inamyloid. CLAMP CONNECTIONS present in all parts of the basidiome.

BIOLUMINESCENCE—Pileus, occasionally brighter in the lamellae and in younger basidiomes. In some collections, the mycelium glows.

ECOLOGY & DISTRIBUTION—Gregarious on twigs of *Quercus* spp. in cloud forests between 1500–1600 m a.s.l.

Material studied—**MEXICO: Veracruz, Municipality of Tlalnelhuayocan**, Rancho Viejo, 23 January 2016, leg. A. Cortés-Pérez 1452, 1453; 24 September 2016, leg. Cortés-Pérez 1750; **Municipality of Coatepec**, road to Coatepec Viejo, 4 February 2017, leg. A. Cortés-Pérez 1846.

Comments—*Panellus stipticus* is a common species with a wide distribution, recorded from North America, Asia, Australasia, and Europe (Breitenbach & Kränzlin 1991, Petersen & Bermudes 1992). Nevertheless, bioluminescence has previously been cited only in populations from eastern North America (Burdsall & Miller 1975; Petersen & Bermudes 1992). While *P. stipticus* is common in western North America, collections there have not been reported as luminescent. Burdsall & Miller (1975), who revised the genus *Panellus*, described *P. stipticus* with basidiospores (3–)3.5–4.5 × 1.2–2.2 µm, elliptical to nearly allantoid in some cases, amyloid; cheilocystidia 17–45 × 3–4.5 µm, narrowly clavate, cylindrical, clavate-rostrate, fusiform to bifurcate at apex, thin-walled, hyaline; and pleurocystidia 17–40 × 3–4.5 µm, fusiform, clavate to clavate-rostrate, sometimes bifurcate at apex, thin-walled, hyaline, scattered or in dense clusters. Breitenbach & Kränzlin (1991) described *P. stipticus* without pleurocystidia; basidiospores 4–5.5 × 2.3–3.2 µm, Q=1.2–2.2; basidia 19–25 × 3.5–5 µm, clavate; and cheilocystidia 40–90 × 5–8 µm, clavate to fusiform, with or without branches. Vellinga (1995) described *P. stipticus* without pleurocystidia; basidiospores 3.5–5(–5.5) × 2–2.5(–3) µm [Q = (1.3–)1.5–1.9(–2.1)], oblong, amyloid; and cheilocystidia crowded, 38–80 × 4–8 µm, irregularly flexuous and cylindrical, sometimes branched, mostly subcapitate or broadened at the apex, sometimes with an apical excrescence, thin-walled, hyaline.

Panellus stipticus is common in the cloud forests in the state of Veracruz, but bioluminescence has not previously been observed here.

Discussion

Chew et al. (2015) reported a total of 81 bioluminescent fungi species in the world. Most of these macromycetes are distributed in tropical and subtropical zones (Desjardin et al. 2008, 2010). There are no published reports of bioluminescent fungi in Mexico despite the great biodiversity and numerous explorations made, probably because to observe the bioluminescence night explorations must be made and it is necessary to walk through the forest without lights after letting the eyes adjust to the dark. The two species mentioned here belong to the family *Mycenaceae* and, according to phylogenetic studies, they are grouped in the Mycenoid lineage (Desjardin et al. 2008). This group has the largest number of bioluminescent species, with more than 60 taxa reported (Desjardin et al. 2008, 2010; Chew et al. 2015).

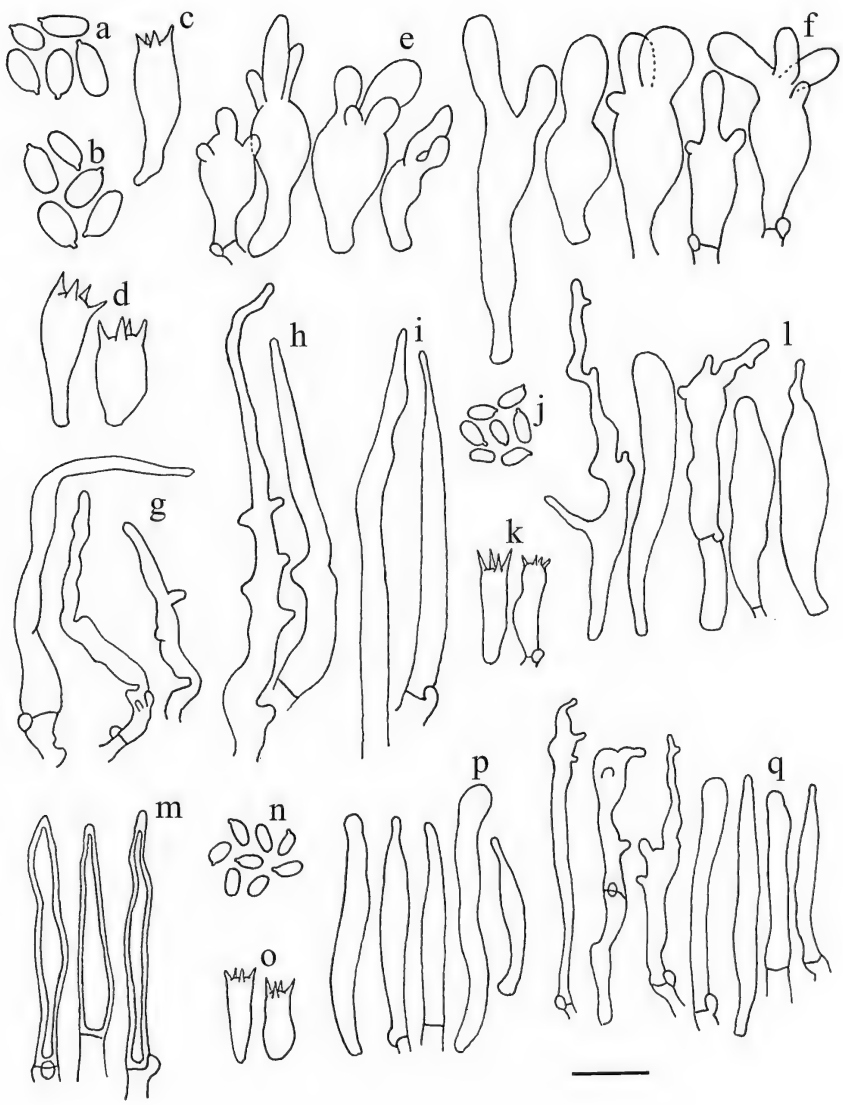

Plate 2. ***Mycena stylobates*** (A, C, E, G, I = A. Cortés-Pérez 1214; B, D, F, H = A. Cortés-Pérez & A. Rockefeller 1344). A, B: basidiospores; C, D: basidia; E, F: cheilocystidia; G, H: caulocystidia; I: basal disc cystidia. ***Panellus stipticus*** (J–M = A. Cortés-Pérez 1452; N–Q = A. Cortés-Pérez 1750). J, N: basidiospores; K, O: basidia; L, Q: cheilocystidia; M: caulocystidia; P: pleurocystidia. Scale bar = 10 µm.

Our research not only has added knowledge of bioluminescent species in Mexico but also contributes to knowledge of the distribution and ecological aspects of these species within the cloud forests.

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The authors are grateful to Dr. Denis Desjardin and Dra. Virginia Ramírez-Cruz for their critical review and comments. Thank you also to Dr. Gastón Guzmán† who always supported us with advice and literature. We also thank Manuel Hernández and Juan Lara Carmona for their help in the edition of figures and herbarium task at Fungi Collection. Alonso Cortés-Pérez thanks CONACyT for the grant to study his master's degree in Ecology at the Universidad Veracruzana.

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Catenularia variegata sp. nov. from southern China, and a first Chinese record of *Xylocladium clautriavii*

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Abstract—A new species, *Catenularia variegata*, is described and illustrated from specimens collected on dead stems in Fujian Province. The fungus is characterized by catenulate obovoid conidia formed on solitary, simple, straight or flexuous conidiophores. *Xylocladium clautriavii* is newly recorded from China.

Key words—hyphomycetes, taxonomy

Introduction

During our ongoing survey of microfungi associated with woody debris in tropical and subtropical forests of Fujian and Guangxi provinces, two species with morphological characteristics of the genera *Catenularia* and *Xylocladium* were collected on dead stems. *Catenularia variegata* is described here as a new species, and *Xylocladium clautriavii* represents a new record from China. Specimens are deposited in the Herbarium of the Department of Plant Pathology, Shandong Agricultural University, Taian, China (HSAUP) and the Mycological Herbarium, Institute of Microbiology, Chinese Academy of Sciences, Beijing, China (HMAS).

Catenularia variegata H.H. Li & X.G. Zhang, **sp. nov.** Fig. 1

MycoBank MB 822506

Differs from *Catenularia cubensis* by its larger, obovoid conidia.

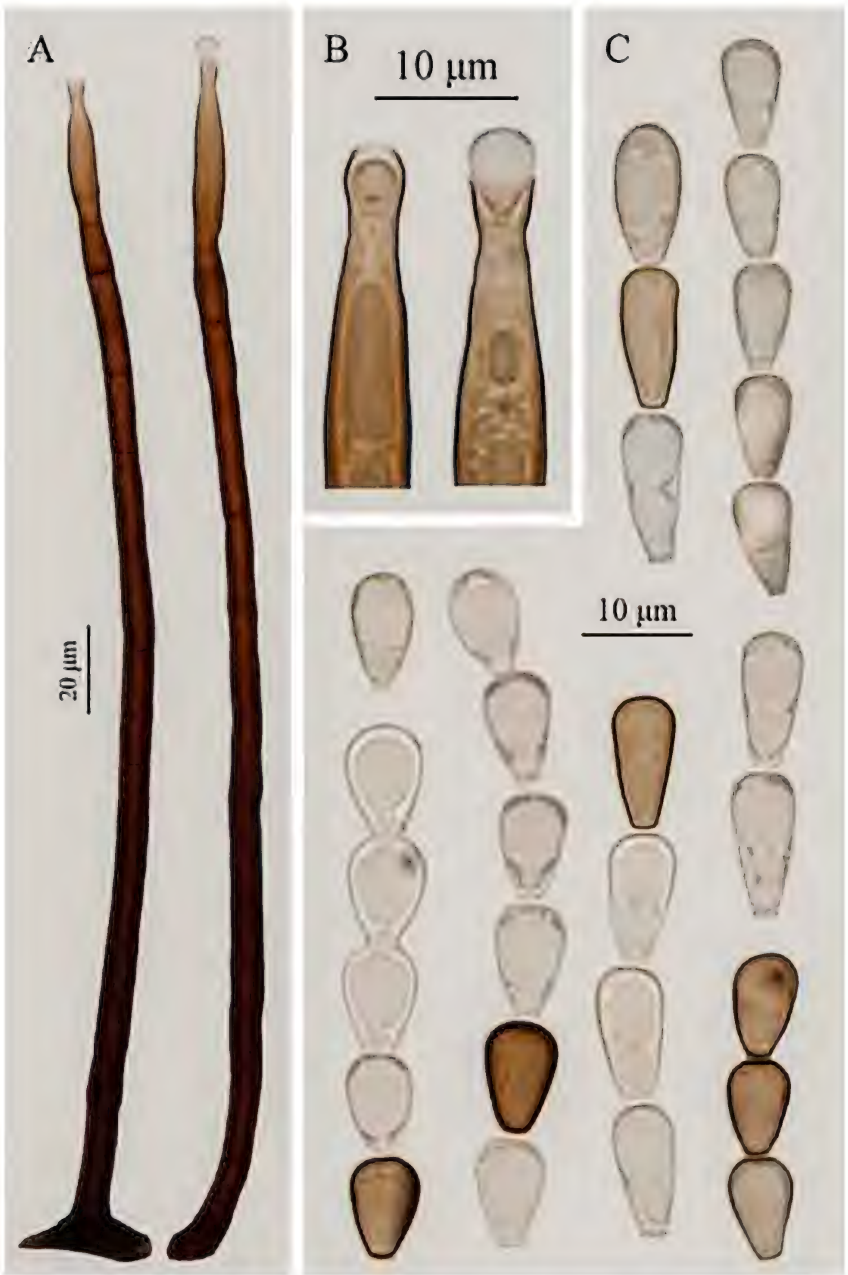

Fig. 1. *Catenularia variegata* (holotype, HSAUP H10178).
A. Conidiophores, conidiogenous cells, and conidia; B. Conidiogenous cells; C. Conidia.

Type: China, Fujian Province: Wuyishan, on dead stems of an unidentified broadleaf tree, 22 Apr. 2016, J.Y. Wang (**Holotype**, HSAUP H10178; **isotype**, HMAS 245641).

Etymology: *variegata*, in reference to the variegated conidial color.

Colonies effuse, brown, hairy. Mycelium partly immersed, partly superficial, composed of subhyaline, smooth-walled, septate hyphae. Conidiophores macronematous, mononematous, simple, erect, straight or flexuous, smooth, 10–12-septate, 150–270 × 4.5–8 μm. Conidiogenous cells monophialidic, integrated, terminal, with a distinct collarette, 22–44 μm long, 4–7 μm diam. Conidia basocatenate, aseptate, obovoid, truncate at the base, smooth, 8.5–11 μm long, 5.5–7.5 μm diam. at the distal broad end, 1.5–2.5 μm diam. at the truncate base, formed in chains of up to 6.

Comments—*Catenularia* Grove was established with *C. simplex* Grove as the type species (Hughes 1965). *Catenularia* is characterized by macronematous, mononematous, simple or flexuous conidiophores and integrated, terminal, monophialidic, collarette conidiogenous cells with solitary, chains, obovoid or cuneiform phragmoconidia. *Catenularia variegata* is morphologically similar to *C. cubensis* Hol.-Jech., which differs by its smaller, rounded-obconic conidia (Holubová-Jechová 1982).

Xylocladium clautriavii (Pat.) P. Syd., in Saccardo & Sydow, Syll. Fung. 16: 1090. 1902. Fig. 2

≡ *Ceratocladium clautriavii* Pat., Bull. Soc. Mycol. France 14: 196. 1898.

≡ *Basiodiobotrys clautriavii* (Pat.) Höhn., Sitzungsber. Kaiserl. Akad. Wiss., Wien,. Math.-Naturwiss. Cl., Abt. 1, 118: 146. 1909.

Conidiophores branched, cylindrical, pale brown, simple, 12–15-septate, 400–550 × 7–8 μm, apex in capitulum. Conidiogenous cells polyblastic, integrated, smooth, dense congested, cylindrical, pale brown, 9–16 × 2.5–5.5 μm. Conidia hyaline, ovoid, simple, smooth wall, pallidly, 4.9–5.5 × 1.5–2.5 μm.

Specimen examined: **China, Guangxi Province**: Longhushan, on dead stems of an unidentified broadleaf tree, 28 Nov. 2015, J.Y. Wang (HSAUP H10129).

Comments – *Xylocladium* P. Syd. ex Lindau [a replacement name for *Ceratocladium* Pat. nom. illeg., non Corda] is typified by *Ceratocladium clautriavii* (Patouillard 1898) and is mainly characterized by branched, cylindrical, simple conidiophores and integrated, polyblastic conidiogenous cells with hyaline, single, dry, ovoid phragmoconidia (Patouillard 1898, as "*Ceratocladium*"; Lindau 1900; Saccardo & Sydow 1902; Höhnel 1909, as "*Basidiobotrys*"; Saccardo & Trotter 1913).

Fig. 2. *Xylocladium clautriavii* (HSAUP H10129).
A–D. Conidiophores; E. Conidiogenous cells; F. Conidia.

Xylocladium has been identified as the anamorphic state of some *Hypoxylon* species (Jong & Rogers 1972), and these species have been transferred to *Camillea*, whose modern diagnosis includes the production of *Xylocladium*

anamorphs [Læssøe et al. 1989); Seifert et al. (2011: 476) suggested that *X. clautriavii* may be the anamorph of *Camillea tinctor* (Berk.) Læssøe et al.]. *Camillea africana* Wakef. has been recorded from China (Teng 1996), but this species does not produce a *Xylocladium* anamorphic state and has been transferred to *Rhopalostroma* (Hawksworth 1977). No previous Chinese record has been found for *X. clautriavii* (or its synonyms and potential teleomorphs). The Chinese specimen corresponds well with the descriptions and illustrations of Jong & Rogers (1972, as "*Hypoxylon punctulatum*" and "*H. tinctor*"), and the illustration of Seifert et al. (2011: Plate 117B).

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Drechslera, Fusariella, Coniochaeta & Pyricularia spp. nov. from soil in China

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Abstract—Four new species from soil in China—*Drechslera elliptica*, *Fusariella verrucosa*, *Coniochaeta xinjiangensis*, and *Pyricularia korlaensis*—are described, illustrated, and compared morphologically with similar species. The type specimens (= dried cultures) and living cultures are deposited in the Herbarium of Shandong Agricultural University: Plant Pathology (HSAUP).

Key words—anamorphic fungi, morphology, taxonomy

Introduction

During a survey of soil dematiaceous hyphomycete diversity in arid and semi-arid areas of northwestern China, *Drechslera elliptica*, *Fusariella verrucosa*, *Coniochaeta xinjiangensis*, and *Pyricularia korlaensis* were obtained as undescribed species. The morphological characteristics of the fungi cultured on potato dextrose agar (PDA) are described. Specimens and living cultures are conserved in the Herbarium, Department of Plant Pathology, Shandong Agricultural University, Taian, China (HSAUP).

Drechslera elliptica H.F. Wang & T.Y. Zhang, **sp. nov.** Fig. 1

MycoBank MB 819404

Differs from *Drechslera sivanesanii* by its larger (especially wider) conidia.

§ Y.L. Jiang and Y.M. Wu contributed equally to this work.

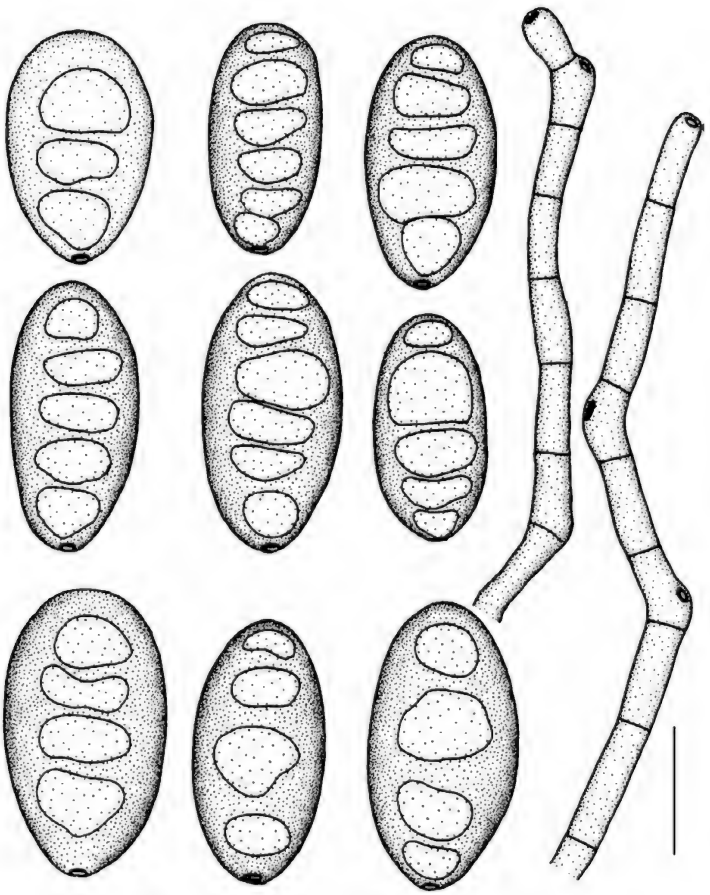

Fig. 1. *Drechslera elliptica* (ex holotype HSAUP $II_{06}5157$). Conidia and conidiophores. Scale bar = 25 μm.

Type: China, Qinghai Province, from a shore soil of Qinghai Lake, 16 August 2006, H.F. Wang (**Holotype**, HSAUP $II_{06}5157$).

Etymology: in reference to the ellipsoidal conidia.

Colonies on PDA effuse, pulvinate, often raised in the middle, velvety, growing moderately, reaching 4–7 cm diam. in 2 weeks at 25 °C. Conidiophores solitary, straight or slightly flexuous, unbranched or occasionally producing 2–3 short branches in the upper part, pale yellowish brown, smooth, 150 μm long or more, 7–8.5 μm diam. Conidia straight, broadly ellipsoidal or ovoid, broadest in the middle, 3–4-pseudoseptate, brown, smooth, 45–58 × 25–32 μm, L/W = 1.8 ± 0.1.

COMMENTS: In conidial morphology, *Drechslera elliptica* resembles *D. sivanesanii* Manohar. & V.R.T. Reddy, which differs by its smaller (especially narrower or more slender) conidia (43–55 × 18.5–22 μm, L/W = 2.5 ± 0.1; Manoharachary & Reddy 1983).

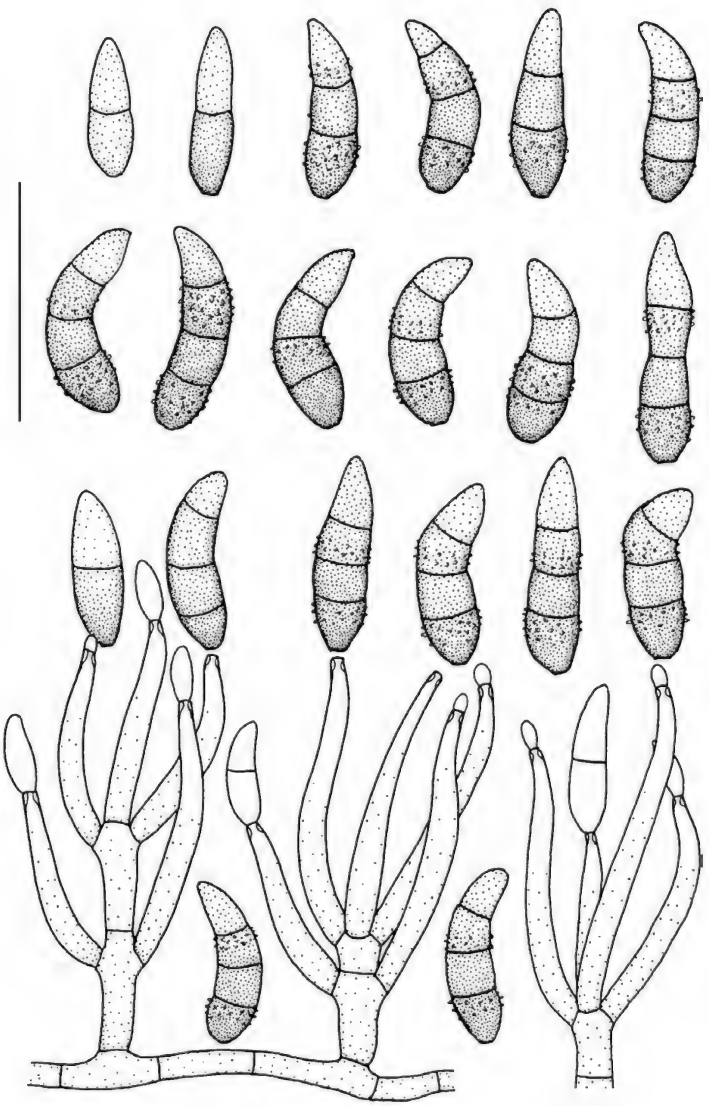

FIG. 2. *Fusariella verrucosa* (ex holotype HSAUP $II_{05}2504$). Conidia, conidiophores, and phialides. Scale bar = 25 μm.

Fusariella verrucosa J.H. Kong & T.Y. Zhang, **sp. nov.** Fig. 2

MycoBank MB 819405

Differs from *Fusariella aegyptiaca* and *F. concinna* by its smooth phialides, and wider, often curved, verruculose conidia.

Type: China, Gansu Province, Dunhuang County, from an orchard soil, 12 July 2005, J.H. Kong (**Holotype**, HSAUP $II_{05}2504$).

Etymology: in reference to the verrucose conidia.

Colonies on PDA slow-growing, effuse, thin, hyaline, finally blackish brown, sporulation zone blue green to dark green, often wrinkled and zonate. Hyphae hyaline, septate, branched, smooth, 1–2.5 µm diam. Conidiophores arise on vegetative hyphae, hyaline, lateral, straight or flexuous, branched, smooth, 1–3 septate, 25–43.5 × 2.5–3 µm. Phialides borne apically or laterally below the septa of the conidiophore, hyaline, smooth, cylindrical, tapering slightly towards the apex, 15.5–34 × 2–3 µm. Conidia fusoid, obclavate, pointed at the apex, straight or curved, greenish brown to dark brown, verruculose, 3-septate, slightly constricted at septa, 15.5–24 × 4–6.3 µm.

Comments: *Fusariella verrucosa* resembles *F. aegyptiaca* Mouch. and *F. concinna* (Syd.) S. Hughes in conidial morphology and size. However, *F. aegyptiaca* differs in its verruculose phialides and conidia that are seldom curved and with the basal cell often swollen to 7–9 µm (Ellis 1976); *F. concinna* is distinguished by its smooth and narrower conidia (16–22 × 3.5–4 µm; Hughes 1949).

Coniochaeta xinjiangensis J.H. Kong & T.Y. Zhang, **sp. nov.** Fig. 3

MycoBank MB 822522

Differs from *Coniochaeta mutabilis* by its pale brown, obovate to ellipsoidal, and wider conidia.

Type: China, Xinjiang Uygur Autonomous Region, Urumqi City, from a park soil, 17 July 2005, J.H. Kong (**Holotype**, HSAUP II_{052735}).

Etymology: in reference to the region where the holotype was collected.

Colonies on PDA effuse, greyish brown, velvety, growing slowly, reaching a diameter of 3–5 cm in 2 weeks at 25 °C. Mycelium superficial and immersed; hyphae brown, smooth, septate, sometimes thick-walled, branched, 1.8–3 µm wide, often forming ropes. Phialides solitary, born laterally and directly from aerial hyphae, lageniform with more or less inflated middle part, collarettes inconspicuous, pale brown to brown, smooth, 1.5–9.5 × 1.5–4 µm. Conidia obovate, broadly obovate to ellipsoidal, unicellular, truncated at the base, smooth, pale brown, 4–9 × 2.5–4 µm. Chlamydospores sometimes present, thick-walled, obovate, dark brown, smooth.

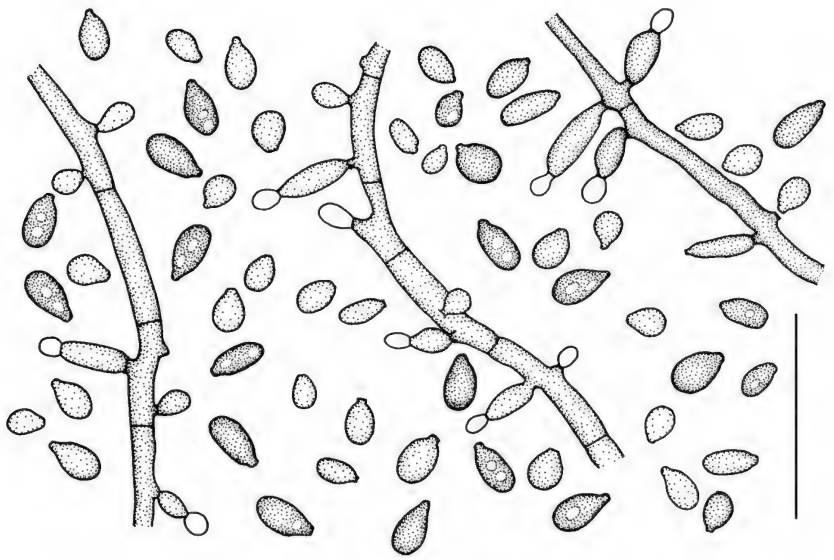

FIG. 3. *Coniochaeta xinjiangensis* (ex holotype HSAUP $II_{05}2735$). Conidia, hyphae, and phialides. Scale bar = 25 μm.

COMMENTS: Species described in the genera *Coniochaeta* (based on sexual morphs) and *Lecythophora* (based on asexual morphs) are considered to be congeneric. Under the "one fungus : one name" principle, the older name *Coniochaeta* has been recommended as the correct name for the holomorphic genus (Réblová et al. 2016), and all nine described *Lecythophora* species have been recombined in *Coniochaeta* (Khan et al. 2013).

In producing flask-shaped phialides and chlamydospores *C. xinjiangensis* is similar to *C. mutabilis* Z.U. Khan et al., which differs in its hyaline, subcylindrical to cylindrical, and narrower (1.8–2.5 μm) conidia (De Hoog 2000).

Pyricularia korlaensis J.H. Kong & T.Y. Zhang, **sp. nov.** FIG. 4

MYCOBANK MB 820186

Differs from *Pyricularia caffra* by its much smaller conidia.

TYPE: China, Xinjiang Uygur Autonomous Region, Korla, from a lawn soil, 19 July 2005, J.H. Kong (**Holotype**, HSAUP II_{052571}).

ETYMOLOGY: in reference to the city where the holotype was collected.

COLONIES on PDA effuse, thinly velvety, raised in the centre, pale olivaceous brown with a white margin, rather slow-growing, reaching a diameter of 2–3 cm in 3 weeks at 25 °C. CONIDIOPHORES macronematous, mononematous,

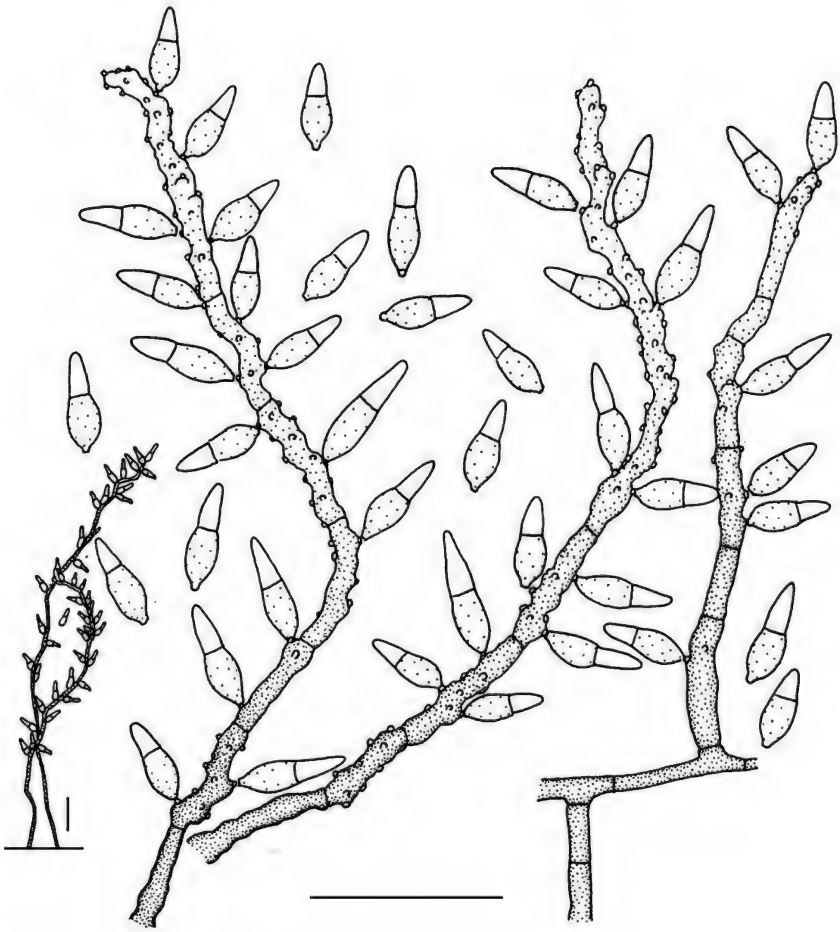

FIG. 4. *Pyricularia korlaensis* (ex holotype HSAUP II_{05}2571). Conidia, conidiophores, and denticles. Scale bars = 25 μm.

unbranched, straight or flexuous, solitary, septate, smooth, geniculate, 30–250 × 2.5–3.5 μm, with denticles towards the apex. CONIDIOGENOUS CELLS polyblastic, terminal, geniculate, sympodial, cylindrical, denticulate. CONIDIA solitary, acropleurogenous, 1-septate, narrowly ovate to obpyriform, sometimes constricted at the septum, pale brown, 7.5–17.5 × 3–4.5 μm.

COMMENTS: Owing to producing bicellular and narrowly ovate to obpyriform conidia, *Pyricularia korlaensis* is most close to *P. caffra* Matsush., which differs by its much larger conidia (20–31.5 × 9–9.5 μm; Matsushima 1996) .

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Tuber magnatum in Thailand, a first report from Asia

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Abstract—Specimens collected in Thailand have been identified as *Tuber magnatum*, based on morphology and phylogenetic analysis of the LSU and ITS sequences. A description and illustration are provided. This is the first record of this fungus from Asia.

Key words—ascomycete, hypogeous fungi, taxonomy, white truffle

Introduction

Truffles (*Tuber* spp., *Tuberaceae*, *Pezizales*) are well known as the most expensive edible fungi in the world (Hall et al. 2003, 2007; Zambonelli et al. 2016). The Italian white truffle (*T. magnatum*), Périgord black truffle (*T. melanosporum* Vittad.), and summer truffle (*T. aestivum* Vittad.) are highly prized foods in Europe (Hall et al. 2007; Stobbe et al. 2013). In North America, Oregon white truffles (*T. oregonense* Trappe et al. and *T. gibbosum* Harkn.) are commercially harvested (Bonito et al. 2011). An Asian black truffle, *T. indicum* Cooke & Massee (the first Asian truffle reported from India; Cooke 1892), is one of the renowned commercial species in China (Mortimer et al. 2012). Since the 1980s, more than 20 new *Tuber* species have been discovered in China, Japan, and Taiwan (Liu & Liu 1994; Tao 1988; García-Montero et al. 2010; Fan et al. 2011a,b, 2012a,b, 2014, 2015; Fan & Cao 2012; Deng et al. 2013; Fan & Yue 2013; Kinoshita et al. 2016), and two new truffles, *T. thailandicum* N. Suwannarach et al. and *T. lannaense* N. Suwannarach & Lumyong have been described from Thailand (Suwannarach et al. 2015, 2016).

During an investigation of hypogenous fungi in northern Thailand, we found specimens that corresponded to the description of *T. magnatum,* a species unknown in Asia and previously reported from Croatia, Hungary, Italy, Serbia, Slovenia, and Switzerland (Hall et al. 1998, 2007; Mello et al. 2005; Rubini et al. 2005; Figliuolo et al. 2013). We describe and illustrate the morphological characters of the Thai material and provide results from molecular phylogenetic analyses.

Materials & methods

Morphology studies

Ascomata were collected under *Carpinus* sp. (*Betulaceae*) in a mixed evergreen hill forest in northern Thailand. Macromorphological descriptions were made within 24 h after collection. Color names and codes follow Kornerup & Wanscher (1978). The specimens were dried at 40–45 °C; sections of dried material were mounted in 95% ethanol and rehydrated in distilled water, 3% KOH, or Melzer's reagent for microscopical examination; at least 50 measurements were made of each structure. *Q* is the length to width ratio and **Q** is the average *Q* of all specimens ± standard deviation. The collections are deposited at the Research Laboratory for Excellence in Sustainable Development of Biological Resources, Faculty of Science, Chiang Mai University, Thailand (SDBR-CMU).

Molecular studies

Genomic DNA of three specimens was extracted from fresh tissue using the Genomic DNA Extraction Mini Kit (Favogen, Taiwan). The large subunit (LSU) of nuclear ribosomal DNA was amplified by polymerase chain reaction (PCR) with LROR and LR5 primers under the following thermal conditions: 95 °C for 2 min; 30 cycles of 95 °C for 30 s, 52 °C for 30 s, 72 °C for 1 min; and 72 °C for 10 min. The internal transcribed spacer (ITS) region of ribosomal RNA gene was amplified with ITS4 and ITS5 primers under the following thermal conditions: 94 °C for 2 min; 35 cycles of 95 °C for 30 s, 50 °C for 30 s, 72 °C for 1 min; and 72 °C for 10 min. PCR products were checked on 1% agarose gels stained with ethidium bromide under UV light and purified using NucleoSpin® Gel and PCR Clean-up Kit (Macherey-Nagel, Germany) following the manufacturer's protocol. The purified PCR products were directly sequenced. Sanger sequencing was performed by 1ST Base Company (Kembangan, Malaysia). Sequences were used to query GenBank database via BLAST (http://blast.ddbj.nig.ac.jp/top-e.html).

The sequences for phylogenetic analysis were obtained in this study and from GenBank database. The multiple sequence alignment was carried out using MUSCLE (Edgar 2004). A maximum likelihood (ML) phylogenetic tree was constructed using RAxML v7.0.3 (Stamatakis 2006), applying the rapid bootstrapping algorithm for 1000 replications using the GTRGAMMA model. *Choiromyces meandriformis* Vittad. and *C. alveolatus* (Harkn.) Trappe were used as the outgroup. The ML trees were viewed with TreeView32 (Page 2001). Bayesian phylogenetic analysis was carried out using

the Metropolis-coupled Markov chain Monte Carlo (MCMCMC) method in MrBayes version 3.2 (Ronquist et al. 2012).

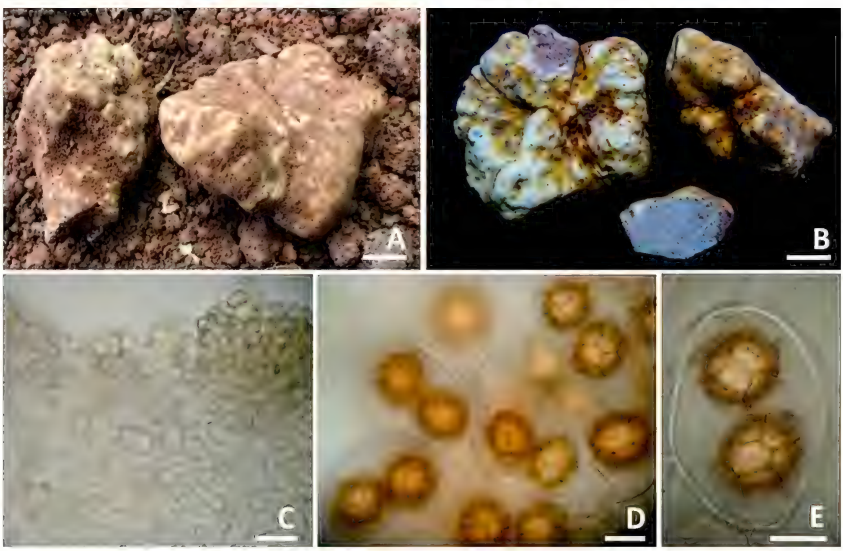

Fig. 1. *Tuber magnatum* (SDBR-CMU-MTUF010). A, B: Ascomata; C: Peridium with pseudoparenchymatous tissues; D, E: Asci and ascospores as observed under a compound microscope. Scale bars: A, B = 10 mm; C = 10 µm; D, E = 25 µm.

Results

Taxonomic description

Tuber magnatum Picco, Meleth. Bot.: 79 (1788). Fig. 1

Ascomata hypogeous, irregular in form, lobed, gibbous, sometimes flattened, 23–65 mm diam., white (2A1) to pale yellow (4A3) when fresh, gradually becoming pale yellow (4A3) to brown (6D8) when dry, surface smooth to verrucose, glabrous. Odor strongly aromatic when mature. Peridium 250–500 µm thick, composed of two layers. Outer layer 150–300 µm thick, pseudoparenchymatous, composed of isodiametric cells, pale yellow or hyaline, 5–25 µm diam., cell walls 0.5–1.5 µm thick; hyphae scattered, hyaline, thin-walled, 2–5 µm diam.. Inner layer 100–200 µm thick, hyphae intricately interwoven, hyaline, 2–5 µm diam., thin-walled. Gleba solid, white when young, becoming pale yellow, reddish brown, often with flesh-red spots, marbled with numerous meandering white veins. Asci globose to subglobose or ellipsoid, hyaline, with thin or slightly thickened walls, 55–125 × 40–115

μm, sessile with short stalk 2–5 μm long, 1–4-spored (mostly 2-spored). Ascospores subglobose to broadly ellipsoid, hyaline when young, becoming light yellow to yellowish brown at maturity; excluding their alveolate-recticulate ornamentation 30–40 × 27.5–32.5 μm, Q = 1.08–1.33 in 1-spored asci, 26.5–30 × 22.5–25 μm, Q = 1.05–1.20 in 2-spored asci, 22.5–25 × 21–23.75 μm, Q = 1.00–1.25 in 3-spored asci, 17–23.75 × 17–22.5 μm, Q = 1.00–1.21 in 4-spored asci, **Q** = 1.13 ± 0.09; spines 1.5–7.5 μm high, constituting mostly of hexagonal meshes 2–3 across the spore width, 12.5–17.5 × 5–12.5 μm,.

Specimens examined—**THAILAND, Chiang Mai Province**, Muang District, Doi Suthep-Pui National Park, Doi Pui, 18°49′52″N 98°54′12″E, elevation 1580 m, under *Carpinus* sp. (*Betulaceae*) in mixed evergreen hill forest, sandy loam, 25 July 2016,

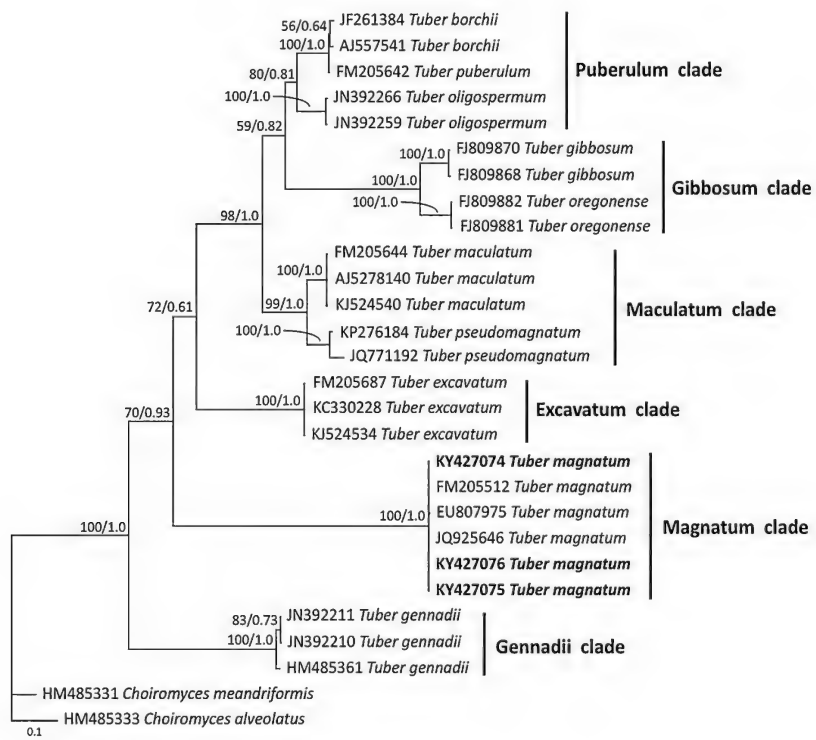

Fig. 2. Phylogram derived from maximum likelihood analysis of the LSU region of nuclear rDNA from 30 sequences. *Choiromyces alveolatus* and *C. meandriformis* were used as the outgroup. The numbers above branches represent maximum likelihood bootstrap percentages (left) and Bayesian posterior probabilities (right). Only bootstrap values ≥50 % are shown. The sequences obtained from this study are in bold.

Suwannarach N. (SDBR-CMU-MTUF010; GenBank KY427071, KY427074); 3 August 2016, Suwannarach N. & Kumla J. (SDBR-CMU-MTUF011; GenBank KY427072, KY427073); 25 August 2016, Suwannarach N. & Kumla J. (SDBR-CMU-MTUF012; GenBank KY427075, KY427076).

Molecular analysis

Bonito et al. (2011) identified six main clades (Excavatum, Gennadii, Gibbosum, Maculatum, Magnatum, and Puberulum) within *Tuber*. Our ITS- and LSU-based phylograms (Figs 2, 3) place the Thai specimens within the monophyletic Magnatum clade with high bootstrap (100%) support and Bayesian posterior probabilities (1.0).

Discussion

Tuber magnatum, the world's most expensive truffle, has previously been reported only from Europe (Hall et al. 1998, 2007; Mello et al. 2005; Rubini

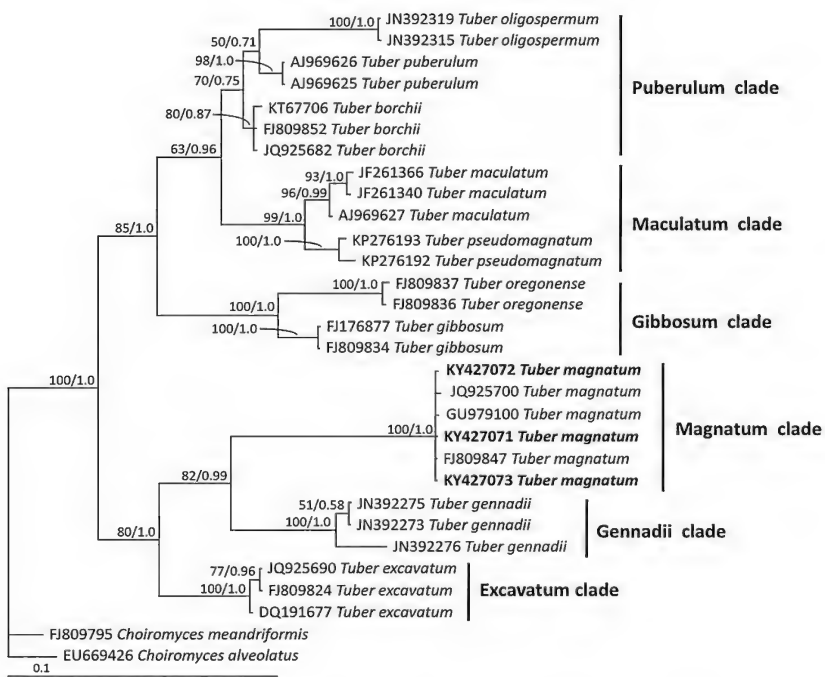

Fig. 3. Phylogram derived from maximum likelihood analysis of the ITS region of nuclear rDNA from 28 sequences. *Choiromyces alveolatus* and *C. meandriformis* were used as the outgroup. The numbers above branches represent maximum likelihood bootstrap percentages (left) and Bayesian posterior probabilities (right). Only bootstrap values ≥50 % are shown. The sequences obtained from this study are in bold.

et al. 2005; Figliuolo et al. 2013). In this study, all three specimens collected in northern Thailand were initially identified as *T. magnatum* based on descriptions by Picco (1788) and Phillips (2006). This species is distinguished from other Asian whitish truffles by its large ascoma size (Hall et al. 1998; García-Montero et al. 2010; Suwannarach et al. 2015, 2016; Zambonelli et al. 2016). *Tuber magnatum* resembles *T. borchii* Vittad., *T. gennadii* (Chatin) Pat., *T. gibbosum*, *T. maculatum* Vittad., *T. oligospermum* (Tul. & C. Tul.) Trappe, and *T. oregonense*. However, detailed morphological analyses reveal these are different species. The peridium in *T. gennadii*, *T. maculatum*, *T. oligospermum*, and *T. oregonense* is prosenchymatous, while in *T. magnatum* it is clearly pseudoparenchymatous (Mello et al. 2000, Bonito et al. 2011, Alvarado et al. 2012). The 1–6 ascospores per ascus in of *T. gibbosum* separate it from *T. magnatum* (Bonito et al. 2011). The ascospores of *T. magnatum* are smaller than those of *T. borchii* (Mello et al. 2000). *Tuber magnatum* is further distinguished from other *Tuber* species by molecular phylogenetic analyses and the unique aroma of its ascomata (Hall et al. 1998, Mello et al. 2005, Bonito et al. 2011, Zambonelli et al. 2016).

Our sequence analyses also confirmed the three Thai specimens as *T. magnatum*. The combination of morphological and molecular characters helps to establish *T. magnatum* as a new record in Thailand. This finding is important to stimulate the investigations of truffles in Thailand and may contribute to our understanding of the distribution of truffles in Asia.

Acknowledgements

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Craspedodidymella matogrossensis gen. & sp. nov. from the Brazilian Amazon rainforest

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Abstract—An interesting hyphomycete collected during investigations of microfungi on decaying branches of a liana in the Brazilian Amazon rainforest is described and illustrated as a new genus and species, *Craspedodidymella matogrossensis*. The new fungus is distinguished by the conidiophore percurrent extensions, very large cracked and multilayer collarette caused by enteroblastic percurrent regeneration, and endogenous septate conidia.

Key words—asexual fungus, taxonomy, tropical fungi

Introduction

In addition to possessing the greatest extent of tropical forest of the world, the Amazon biome stands out for its great biological diversity (Marengo 2007). Saprobic hyphomycetes have been widely studied in the Brazilian semi-arid region, but in the Amazon those fungi are still poorly known (Monteiro et al. 2014). A survey of hyphomycetes associated with lianas was undertaken in the Brazilian Amazon Forest and an interesting phialidic fungus was discovered. This fungus showed differences from all the previously described species and represents a new genus and species, which are described and illustrated here.

Materials & methods

Samples of woody debris of lianas were collected at the Amazon forest in Mato Grosso state, Cláudia city, placed in paper bags, and taken to the laboratory at Universidade Federal de Mato Grosso. The samples were treated according to Castañeda-Ruiz et al. (2016). Permanent slides were prepared in PVL resin (polyvinyl alcohol, lactic acid, and phenol) and reproductive structures were measured. Micrographs were obtained with a BX51 Olympus compound microscope equipped with bright field and Nomarski interference optics. The type specimen was deposited in the Herbarium of Universidade Federal de Mato Grosso, Sinop, Brazil (CNMT).

Taxonomy

Craspedodidymella F.R. Barbosa, R.F. Castañeda & Gusmão, **gen. nov.**

MycoBank MB 820502

Differs from *Craspedodidymum* by its more distinct multilayered collarette and by its endogenous conidia.

Type: *Craspedodidymella matogrossensis* F.R. Barbosa et al.

Etymology: Latin, *Craspedodidym-* referring to the genus *Craspedodidymum*; Latin, *-ella*, a diminutive.

Asexual fungus. Conidiophores macronematous, mononematous, septate, straight or flexuous, pigmented. Conidiogenous cells enteroblastic, with several successive enteroblastic percurrent regenerations of the inner wall in the collarette after the production of each conidium, very distinct multilayered collarette, pigmented; conidial secession schizolytic. Conidia solitary, endogenous, septate, pigmented.

Craspedodidymella matogrossensis F.R. Barbosa, R.F. Castañeda & Gusmão, **sp. nov.** Figs 1,2

MycoBank MB 820503

Differs from *Craspedodidymum* species by its very large multilayered collarette and its endogenous conidial ontogeny.

Type: Brazil, Mato Grosso State, Claudia city, 11°34′54″S 55°17′15″W, on decaying wood of liana, 08.IV.2016, coll. F.R. Barbosa (**Holotype**: CNMTf 39).

Etymology: *matogrossensis*, refering to the location where the fungus was found.

Colonies scattered, dark brown. Conidiophores macronematous, mononematous, robust, erect, straight or flexuous, unbranched, 8–13-septate (mainly 9-septate), with percurrent extensions, brown, smooth, 235–480 × 5–5.5 µm. Conidiogenous cells enteroblastic, monophialidic, terminal, determinate, brown to pale brown, 47–62 × 4–5 µm, with a very distinct cracked and multilayered collarette, 8–14 × 10–13 µm resulting from percurrent

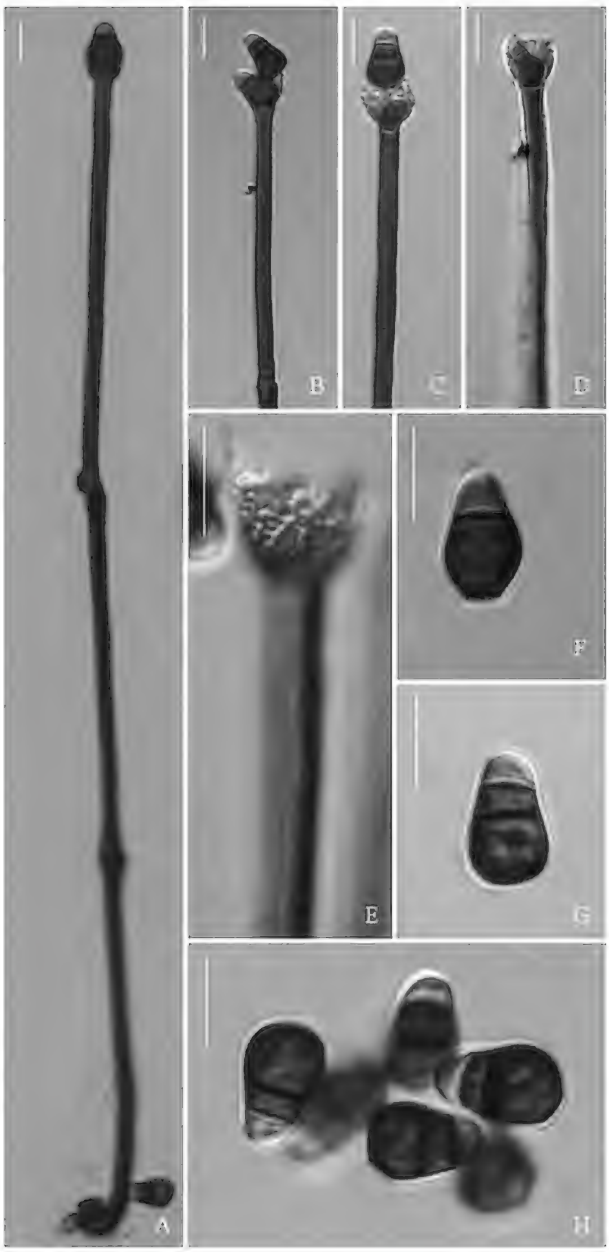

Fig. 1. *Craspedodidymella matogrossensis* (holotype, CNMTf 39). A. Conidiophore, conidiogenous cell, and conidia on the natural substrate; B–D. Details of the conidiophore apex with conidia; E. Details of the cracked conidiogenous cells; F–H: Conidia. Scale bars = 10μm.

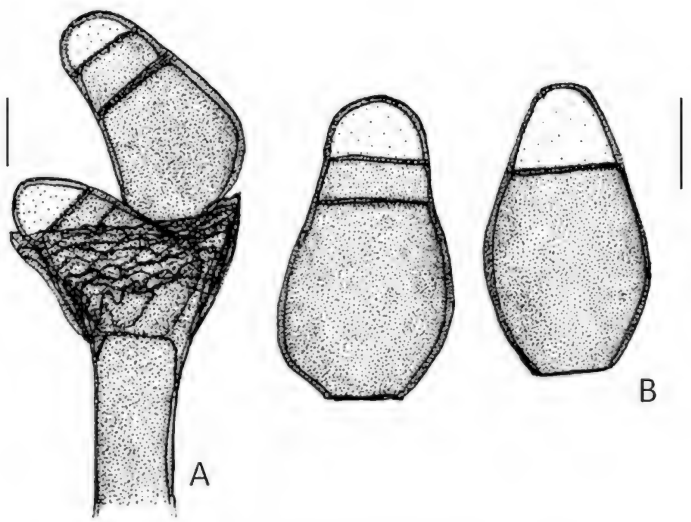

Fig. 2. *Craspedodidymella matogrossensis* (holotype, CNMTf 39).
A. Details of the conidiophore apex with conidia. B. Conidia. Scale bars = 5 µm.

regenerations. Conidial secession schizolytic. Conidia solitary, broadly ovoid, fixed laterally by a swollen basal cell, slightly curved, 1–2-septate, rounded at the apex, basal cell dark brown, sometimes eccentric subtruncate, intermediate cell brown and apical cell light brown, smooth, dry, 13–15 µm long, 8–10 µm thick in the broadest part and 5–6 µm thick in the narrowest part.

Comments—*Craspedodidymum* Hol.-Jech. was typified by *C. elatum* Hol.-Jech. collected from a palm petiole (Holubová-Jechová 1972). That genus is characterized by conidia that are solitary, 0-4-septate, brown to dark brown, and semi-endogenous with a funnel-shaped collarette (Holubová-Jechová 1972, Seifert et al. 2011), while in *Craspedodidymella* conidia are endogenously produced through a broad multilayered collarette. The multilayered collarette is the result of repeated enteroblastic percurrent regenerations of the conidiogenous cells. This event is similar to a pattern of conidiogenesis described by Kirk et al. (2008: Fig 2, #20).

The new genus *Anacraspedodidymum* C.R. Silva et al. (Silva et al. 2014) also produces a collarette but differs from *Craspedodidymella* by having hyaline basal apiculate conidia that sometimes have mucilaginous adherences.

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Notes on some myxomycetes from Crimea (Ukraine)

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Abstract—Twenty-seven collections of myxomycetes represented by field collections obtained in two nature reserves from southern Crimea were studied. Among 25 species identified, *Diderma effusum, D. montanum, Didymium difforme*, and *Perichaena pedata* represent new records for Crimea, and *Physarum hongkongense* is recorded from the Ukraine for the first time. LM and SEM microphotographs are provided for rare or uncommon species recorded in the study area to illustrate their micromorphology.

Key words—*Amoebozoa,* chorology, myxobiota, slime moulds, taxonomy

Introduction

The Crimean peninsula, which occupies a part of the northern Black Sea coast, covers 26,200 km^2 (Leontyev et al. 2011). The climate of Crimea varies over a broad range, depending on the proximity to the sea and topography. The northern peninsula is covered by steppes, while in the south habitats with a Mediterranean climate can be found, protected from the northerly winds by the influence of the Black Sea and the Crimean Mountains.

The myxomycetes described below were collected in two nature reserves of southern Crimea: the Crimean Nature Reserve and Yalta Mountain-Forest

FIG. 1. Location of the two nature reserves studied in southern Crimea: the Crimean Nature Reserve and the Yalta Mountain-Forest Reserve.

Reserve. Both are located on the southern coast of the peninsula (FIG. 1). The territory of both reserves is covered predominately by mountain forests of beech (*Fagus*), oak (*Quercus*), hornbeam (*Carpinus*), and pine (*Pinus*).

The first data relating to Crimean myxomycetes were published by the French mycologist J.H. Léveillé (1842), who found four species of these organisms on the territory of peninsula. For more than one century after this work, only fragmentary data were published about Crimean myxomycetes, until Y.K. Novozhilov, using the moist chamber culture method, recorded 26 species of these organisms in the Nikita Botanic Garden and Cape Martyan Nature Reserve (Novozhilov 1988). At the same time, studies of xerophytic myxomycetes were carried out mostly in mountain forest areas (Dudka et al. 1999, Leontyev 2005), and Dudka (2000) provided the first data on the diversity of nivicolous myxomycetes of Crimea.

A comprehensive study of myxomycete diversity and ecology in the Crimean Nature Reserve was carried out by K.O. Romanenko, who collected there 105 myxomycetes, mostly from *Physarum* (10 species), *Arcyria* (9), *Trichia* (9), *Cribraria* (9), *Licea* (7), *Stemonitis* (6), *Perichaena* (6), and *Echinostelium* (6) (Romanenko 2002, 2006). In 2008, the 6th International Congress for Systematics and Ecology of Myxomycetes was held in Crimea, and the

illustrated list of myxomycetes found during congress forays was published as a separate monograph (Leontyev et al. 2009). Some of these collections were later used to study the morphology of 14 rare myxomycetes that appeared to be new for Crimea and the Ukraine (Leontyev et al. 2011). Two new species have recently been described based in part on the material collected in Crimea (Leontyev et al. 2015). Currently, 121 species of myxomycetes are known from the peninsula.

In the studies mentioned above, a number of myxomycete collections were not correctly identified, and we present our morphological and ultrastructural conclusions below. While we focus on rare and new findings, we also provide information about well-known species for which original collections were misidentified.

Material & methods

The examined material includes specimens obtained from field samples collected by K.O. Romanenko, I.O. Dudka, and V.V. Kuzub and originally attributed to 24 myxomycete species. Specimens are kept in the herbarium of the Life Sciences Department (Botany), University of Alcalá, Madrid, Spain (AH).

Spore measurements (taken using oil immersion) include surface structures such as spines or warts. Light microscopy (LM) was carried out with the Nikon eclipse 80i microscope equipped with an automatic photographic system DS-5M. Scanning electron micrographs (SEM) were provided by a Zeiss DSM-950 microscope.

For ultramicroscopic studies, material was rehydrated in concentrated ammonium hydroxide (28–30%) for 30 min, dehydrated in aqueous ethanol (70%) for 30 min, fixed for 2 h in pure ethylene glycol dimethyl ether (1,2–dimethoxymethane), and finally immersed in pure acetone for at least 2 h. This was followed by critical point drying and sputtering with gold-palladium. This technique allows the use of very little material (i.e., part of a single sporocarp or sometimes no more than a few spores).

Taxonomy

Arcyria stipata (Schwein.) Lister, Monogr. Mycetozoa: 189 (1894) Fig. 2a–c

Sporocarps reddish brown to olivaceous brown, with long stalks. Peridium evanescent, its remnants forming a calyculus. Capillitium brown-olivaceous at maturity, attached by few threads in the centre of the calyculus. The capillitium is formed by spiral filaments, clearly visible by SEM, accompanied by small warts (not visible in LM). Spores, 6–8 µm diam., globose to subglobose, hyaline-yellow in transmitted light, ornamented with two types of warts: [1] comparatively large and forming small clusters and [2] rather small and evenly distributed on the spore surface [both 1&2 visible under SEM, but 2 not visible in LM].

Specimens examined: **UKRAINE, Crimea, Crimean Nature Reserve**, Chatyr-Dag, wood of *Fagus sylvatica*, 9-X-1999, leg. I.O. Dudka fc-501 (AH 46381); Izobilniy forestry, cordon Black River, 800 m, beech forest, wood of *Fagus sylvatica*, 21-IX-2000, leg. K.O. Romanenko fc-267 (AH 45899).

Diderma effusum (Schwein.) Morgan,
J. Cincinnati Soc. Nat. Hist. 16: 155 (1894) Figs 2d, 3a

This sample consists of two pieces of wood with several sessile sporocarps and short plasmodiocarps. The peridium is composed of two layers: the outer layer calcareous and the inner layer membranous. Columella not observed. The capillitium is formed by smooth hyaline filaments. Spores 8–9 µm diam., globose to subglobose, pale brown in transmitted light (LM), verrucose. As seen by SEM, the warts sometimes fuse together to form short crests.

Specimen examined: **UKRAINE, Crimea, Yalta Mountain-Forest Nature Reserve**, Waterfall Uchan-Su, wood of deciduous tree, 17-V-2000, leg. V.V. Kuzub fc-503 [as *Diderma* cf. *deplanatum*] (AH 45900).

Remarks—*Diderma deplanatum* Fr. shows a capillitium formed by darker, nodulose filaments and spores with spinulose ornamentation (Martin & Alexopoulos 1969). *Diderma effusum* is a cosmopolitan species, distributed in both the northern and southern hemispheres (http://discoverlife.org). This represents a first report for the Crimea.

Diderma montanum (Meyl.) Meyl., Diagn. Mycoth. Univ. Cent. 53: 454 (1921)
Fig. 3b

Sporocarps stalked, with double peridium. Stalk white or cream colour, short. Columella whitish, occupying the large portion of the inner sporocarp. Capillitium formed by slightly sinuous filaments, branched, with nodules, faintly violet. Spores 10–10.5 µm diam., globose to subglobose, violet, ornamented with prominent visible warts.

Specimen examined: **UKRAINE, Crimea, Crimean Nature Reserve**, Central forestry, the mountain ridge Sinap-Dag, 1000 m, beech forest, leaf litter of *Fagus sylvatica*, 15-VII-2001, leg. K.O. Romanenko fc-293 [as *Diderma radiatum*] (AH 45901).

Remarks— This sample originally was identified as *Diderma radiatum* (L.) Morgan, which is distinguished by its occurrence on woody substrates and the

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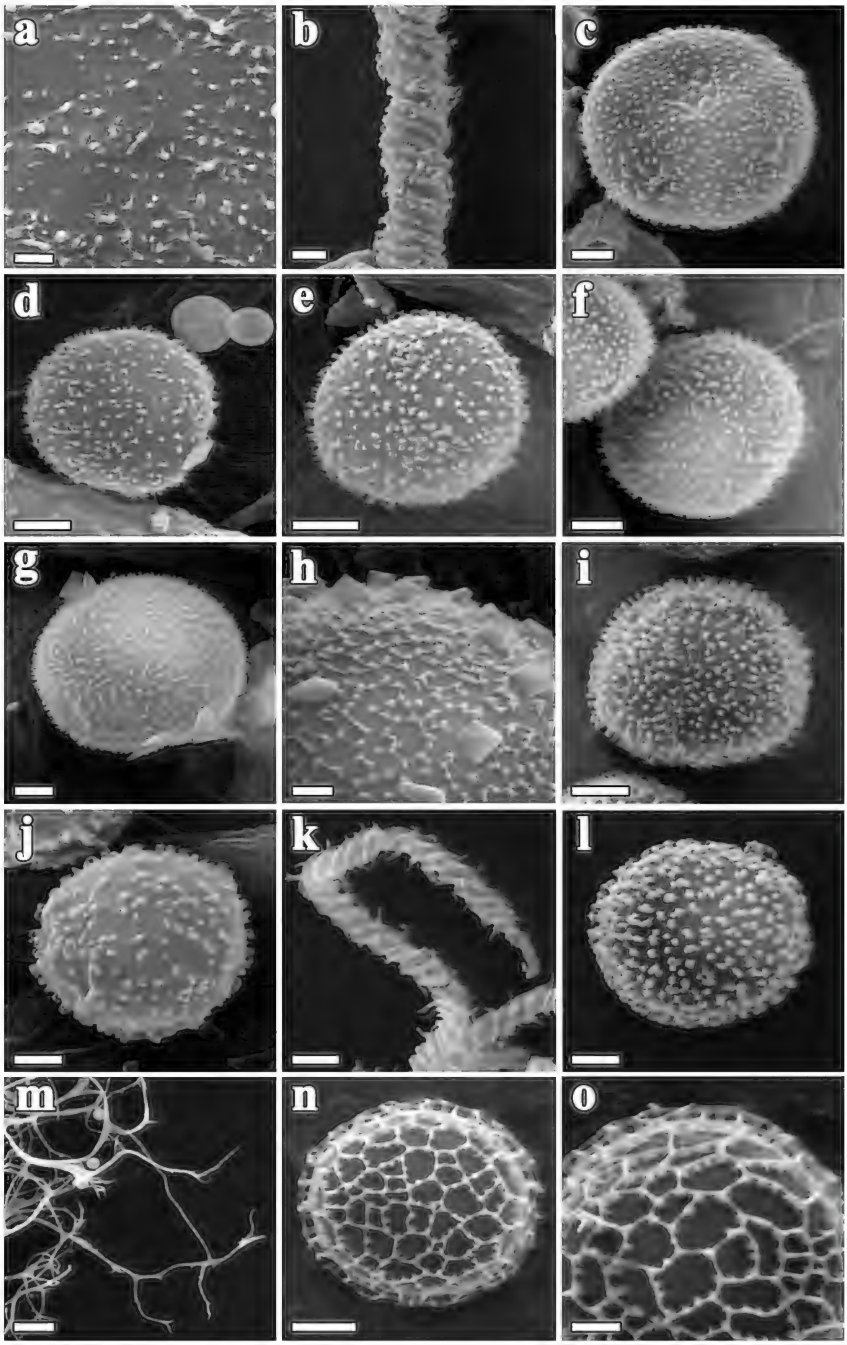
Fig. 2. ***Arcyria stipata***: a. Inner surface of calyculus; b. Detail of capillitium; c. Spore. ***Diderma effusum***: d. Spore. ***Diderma testaceum***: e. Spore. ***Didymium anellus***: f. Spore. ***Didymium difforme***: g. Spore ornamentation; h. Spore. ***Didymium minus***: i. Detail of spore ornamentation. ***Didymium trachysporum***: j. Spore. ***Metatrichia vesparium***: k. Detail of capillitium; l. Spore ornamentation. ***Symphytocarpus amaurochaetoides***: m. Free ends of capillitium; n. Spore; o. Detail of spore ornamentation. Scale bars: a, b, d–g, i, j, l, n = 2 µm; c, h, o = 1 µm; k = 5 µm; m = 20 µm.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brownish peridium, which dehisces to form stellate breaking plates. The sample is similar to the Poulain et al. (2011) representation of *Diderma montanum* var. *album* (Torrend) G. Lister, showing the whitish sporotheca and stalk.

A study of the SEM spore ornamentation was by Sánchez & Moreno (2014).

Diderma montanum is widely distributed in the northern hemisphere (http://discoverlife.org); this represents a first report from Crimea.

Diderma spumarioides (Fr.) Fr., Syst. Mycol. 3: 104 (1829)

Sporocarps large, hemispherical, sessile, whitish, grouped on a wide white hypothallus. Peridium fragile. Columella whitish, globose to pulvinate. Capillitium branched, formed by hyaline filaments, straight, ornamented with occasional nodules. Spores 10–11 µm diam., globose to subglobose, pale brown in transmitted light, verrucose.

Specimen examined: **UKRAINE**, **Crimea**, **Crimean Nature Reserve**, Bakhchysarai forestry, cordon Ammonalniy, 700 m, oak–maple forest, leaf litter of *Acer campestre* and *Quercus robur*, 25-VII-2001, leg. K.O. Romanenko fc-288 (AH 45902).

Remarks—Buyck (1988) analyzed the differences between *D. spumarioides* and two similar species, *Diderma cinereum* Morgan and *D. globosum* Pers.: *D. cinereum* is distinguished by its very slender and flexuous capillitium that is not formed by hyaline straight filaments, while *D. globosum* has a distinctly double peridium with widely separated layers, while *D. spumarioides* has a peridium which appears to be single (sometimes clearly double) but with both layers always adhering very closely.

Diderma testaceum (Schrad.) Pers., Syn. Meth. Fung.: 167 (1801) Figs 2e, 3c

This specimen consists of nearly 100 sporocarps, seated on leaf litter. Sporocarps sessile. Peridium double, the outer layer crustaceous similar to an eggshell, pinkish to pink-violaceous. The inner layer membranous, yellowish-brown. Columella the same colour as the outer layer of the peridium. Capillitium formed by branched filaments, very thin (1 µm diam.) hyaline, with violaceous areas. Spores 8–9 µm diam., globose to subglobose, pale-brown, minutely warted. Warts under SEM show an irregular distribution, with 2–3 baculae sometimes fusing to form short crests.

Specimen examined: **UKRAINE**, **Crimea**, **Crimean Nature Reserve**, Bahchesaray forestry, cordon Olen, 600 m, durmast forest, leaf litter of *Quercus petraea*, 4-X-2001, leg. K O. Romanenko fc-435 (AH 45903).

Didymium anellus Morgan, J. Cincinnati Soc. Nat. Hist. 16: 148 (1894) Fig. 2f

The specimen includes abundant sporocarps, formed on leaf litter. Sporophores: sporocarps globose, plasmodiocarps short umbilicate. Peridium

double-layered, the outer layer formed by calcium carbonate crystals and the inner membranous, tessellate, brown. Dehiscence stellate. Columella prominent, large, globose to flattened, with whitish crystals inside. Capillitium abundant, formed by branched hyaline tubes about 1 μm diam. Spores 8–10 μm diam., globose to subglobose, pale violet, verrucose, with groups of warts more prominent. Under the SEM spores appear ornamented primarily by small evenly distributed warts, with some larger warts gathered in small groups.

Specimen examined: **UKRAINE, Crimea, Crimean Nature Reserve**, Central forestry, the plateau Babugan-Yayla, 900 m, beech forest, leaf litter of *Fagus sylvatica*, 27-VII-2001, leg. K.O. Romanenko fc-296 (AH 45903).

Didymium clavus (Alb. & Schwein.) Rabenh., Deutschl. Krypt.-Fl. 1: 280 (1844)

Sporocarps stalked. Sporotheca disc-shaped, seated on a short and wide stalk. Peridium whitish, formed by calcium carbonate crystals. Stalk black-brown to black, longitudinally striate. Capillitium sparse, formed by hyaline threads. Spores 5–6 μm diam., globose to subglobose, violet-brown, verrucose.

Specimens examined: **UKRAINE, Crimea, Crimean Nature Reserve**, Central forestry, the hill Big Chuchel, 900 m, beech forest, leaf litter of *Fagus sylvatica*, 13-VII-2001, leg. K.O. Romanenko fc-292 (AH 45904); 13-VII-2001, leg. K.O. Romanenko fc-306 (AH 45905).

Didymium difforme (Pers.) Gray, Nat. Arr. Brit. Pl. 1: 571 (1821) Figs 2g,h, 3d

Sporophores: sporocarps sessile pulvinate, plasmodiocarps short. Peridium double, the outer wall crustose, the inner smooth. Capillitium composed of scanty, dichotomously branching threads. Spores minutely verrucose under LM.

Specimens examined: **UKRAINE, Crimea, Crimean Nature Reserve**, Central forestry, the plateau Babugan-Yayla, 1000 m, alpine meadow, on the live stem of *Sideritis montana*, 27-VII-2001, leg. K.O. Romanenko mc-448 (AH 46048 – two boxes); 27-VII-2001, leg. K.O. Romanenko mc-442 [as *Didymium trachysporum*] (AH 46049).

Remarks—*Didymium difforme* is a cosmopolitan species (http://discoverlife.org); however, there are no previous records from Crimea.

Didymium minus (Lister) Morgan, J. Cincinnati Soc. Nat. Hist. 16: 145 (1894) Figs 2i, 3e

The specimen is represented by scattered sporophores in large colonies on leaf litter. Sporocarps sessile, globose with short plasmodiocarps, ≤1 mm diam. Peridium covered with white calcium carbonate crystals. Columella large, globose and sessile, rust-brown and dark brown. Capillitium formed by hyaline filaments ≤1 μm diam. Spores (7.5–)8–10 μm diam., globose to subglobose,

violet-brown, warted, with darker warts gathered in groups. The SEM shows an ornamentation of prominent and densely aggregated warts.

Specimen examined: **UKRAINE, Crimea, Crimean Nature Reserve**, Central forestry, the mountain ridge Sinap-Dag, 1000 m, beech forest, leaf litter of *Fagus sylvatica*, 4-X-2001, leg. K.O. Romanenko fc-304 [as *Didymium melanospermum*] (AH 45908).

Didymium nigripes (Link) Fr., Syst. Mycol. 3: 119 (1829)

This sample has been identified as *Didymium nigripes* based on its stipitate sporocarps, rarely exceeding 1 mm in height with a stalk at least 2 times larger than the sporothecal diameter. Peridium covered by white calcium carbonate crystals. Stalk dark-brown to black. Columella subglobose, dark-brown. Spores, 8–9 µm diam., globose to subglobose, violet-brown, ornamented with warts, some of which are in clusters.

Specimen examined: **UKRAINE, Crimea, Yalta Mountain-Forest Reserve**, Gurzuf forestry, oak forest, leaf litter of *Quercus pubescens*, 5-X-1999, leg. I. O. Dudka fc-502 [as *Didymium minus*] (AH 45909).

Remarks—*Didymium bahiense* Gottsb. is a species closely related to *D. nigripes* but its white columella contrasts with the black or dark-brown columella of *D. nigripes*. In addition, *D. nigripes* has a thinner stalk and smaller spores.

Didymium squamulosum (Alb. & Schwein.) Fr., Symb. Gasteromyc.: 19 (1818)

Sporocarps scattered, stipitate, forming large colonies. Sporotheca subglobose to lenticular. Peridium single, covered with white calcium carbonate crystals. Stalk amber or honey-yellow, with orange tints. Columella globose, the same color as the stalk. Capillitium hyaline to pale gray. Spores 10–11 µm diam., globose to subglobose, dark purplish- brown, with prominent dense warts and often collapsing into polygonal shapes.

Specimen examined: **UKRAINE, Crimea, Crimean Nature Reserve**, Bakhchysarai forestry, cordon Ammonalniy, 700 m, oak–maple forest, leaf litter of *Acer campestre* and *Quercus robur*, 25-VII-2001, leg. K.O. Romanenko fc-287 (AH 45910).

Remarks—*Didymium squamulosum* is a cosmopolitan species (Martin & Alexopoulos 1969).

Didymium trachysporum G. Lister, Essex Naturalist 20: 113 (1923) Fig. 2j

Sporocarps sessile, small, 0.1–0.2 mm diam, globose. Peridium double, with very firmly fused layers: the outer layer forming a white to pale-gray crust, the inner layer hyaline. Columella absent or rudimentary. Capillitium poorly developed, consisting of straight filaments, hyaline to slightly colored ≤1 µm diam. Spores 10–11 µm diam., globose to subglobose, violet, ornamented by

prominent warts, irregularly distributed with 2–3 sometimes fused into short crests. Under SEM the irregularly distributed warts are observed on spore surface.

Specimen examined: **UKRAINE, Crimea, Crimean Nature Reserve**, Yalta forestry, the plato Nikitskaya Yayla, 1325 m, alpine meadow, on mosses and soil, 13-VI-2000, leg. K.O. Romanenko mc-5 (AH 45911).

Remarks—*Didymium trachysporum* was first recorded for the Crimea by K.O. Romanenko (2002); our record represents the second for the peninsula.

Licea kleistobolus G.W. Martin, Mycologia 34: 702 (1942) Fig. 3f

This species can be easily recognized by its sessile sporocarps with a grayish, weakly iridescent broad apical operculum. Spores 7–8 μm diam., globose to subglobose, yellowish-hyaline in transmitted light, ornamented with warts and groups of prominent warts.

Specimen examined: **UKRAINE, Crimea, Crimean Nature Reserve**, Izobilniy forestry, cordon Taryer, 700 m, pine forest, bark of *Pinus pallasiana*, 26-IX-2000, leg. K.O. Romanenko mc-429 (AH 45912).

Remarks—A thorough SEM study of *Licea kleistobolus* material from Baja California (Mexico) was carried out by Moreno et al. (2001).

Licea minima Fr., Syst. Mycol. 3: 199 (1829) Fig. 3g,h

Sporocarps sessile. Peridium splitting into polygonal plates, with the edges of each plate covered by tooth-like warts. Spores 9–10 μm diam., globose to subglobose, rust-brown in mass and pale brown olivaceous in transmitted light, ornamented by prominent warts.

Specimens examined: **UKRAINE, Crimea, Crimean Nature Reserve**, Bakhchysarai forestry, the mountain ridge Uskularskiy, 700 m, pine forest, dead wood of *Pinus sylvestris*, 2-VIII-2001, leg. K.O. Romanenko mc-463 (AH 45913); Yalta forestry, cordon Grushovaya Polyna, 700 m, pine forest, dead wood of *Pinus* sp., 6-X-2001, 700 m, leg. K.O. Romanenko mc-387 (AH 45914).

Licea operculata (Wingate) G.W. Martin, Mycologia 34: 702 (1942) Fig. 3i,j

Sporocarps stipitate, 0.5–0.8 mm high overall. Sporotheca 0.05–0.1 mm diam., dehiscing by means of a round lid (operculum). Peridium blackish brown. Stalk 2–4 times longer than sporothecal diameter. Spores 10–11 μm diam., globose to subglobose, hyaline-yellow, smooth and with a thickened wall portion.

Specimen examined: **UKRAINE, Crimea, Crimean Nature Reserve**, Izobilniy forestry, cordon Asport, 450 m, bark of *Picea abies*, 2-X-2000, leg. K.O. Romanenko mc-202 (AH 45915).

Remarks—A complete study of *Licea operculata* including the SEM photographs was carried out by Wrigley de Basanta & Lado (2005).

Licea parasitica (Zukal) G.W. Martin, Mycologia 34: 702 (1942) Fig. 3k

Sporocarps globose to pulvinate. Peridium opening through an operculum that covers the apical half of the sporotheca. Spores 14–15 µm diam., globose to subglobose, dark-brown in mass, greenish in transmitted light, smooth, with pale area covering a quarter to a half of the spore surface.

Specimen examined: **UKRAINE**, **Crimea**, **Crimean Nature Reserve**, Bakhchysarai forestry, cordon Zubrovaya Polyana, bark of *Taxus baccata*, 18-VII-2001, 500 m, leg. K.O. Romanenko, mc-331, AH 45916.

Licea variabilis Schrad., Nov. Gen. Pl.: 18 (1797) Fig 3l

Sporophores are sessile sporocarps or plasmodiocarps. Peridium dark-brown, dehiscence irregular. Spores 10–12 µm diam., globose to subglobose or oval, grey in mass, pale yellow in transmitted light, with spinulose ornamentation.

Specimen examined: **UKRAINE**, **Crimea**, **Crimean Nature Reserve**, Central forestry, cordon Bukovskiy, 900 m, beech forest, wood of *Fagus sylvatica*, 10-VII-2001, leg. K.O. Romanenko mc-363 (AH 45917).

Metatrichia vesparium (Batsch) Nann.-Bremek. ex G.W. Martin & Alexop., Myxomycetes: 143 (1969) Figs 2k,l, 3m

Sporocarps clustered on common stalk. Peridium thick, dark-brown. Stalk reddish-brown. Capillitium reddish, formed by elaters with slightly marked spiral bands that are ornamented with 1–2 µm long spines. Spores 9–10 µm diam., globose to subglobose, pale yellow, minutely spinulose.

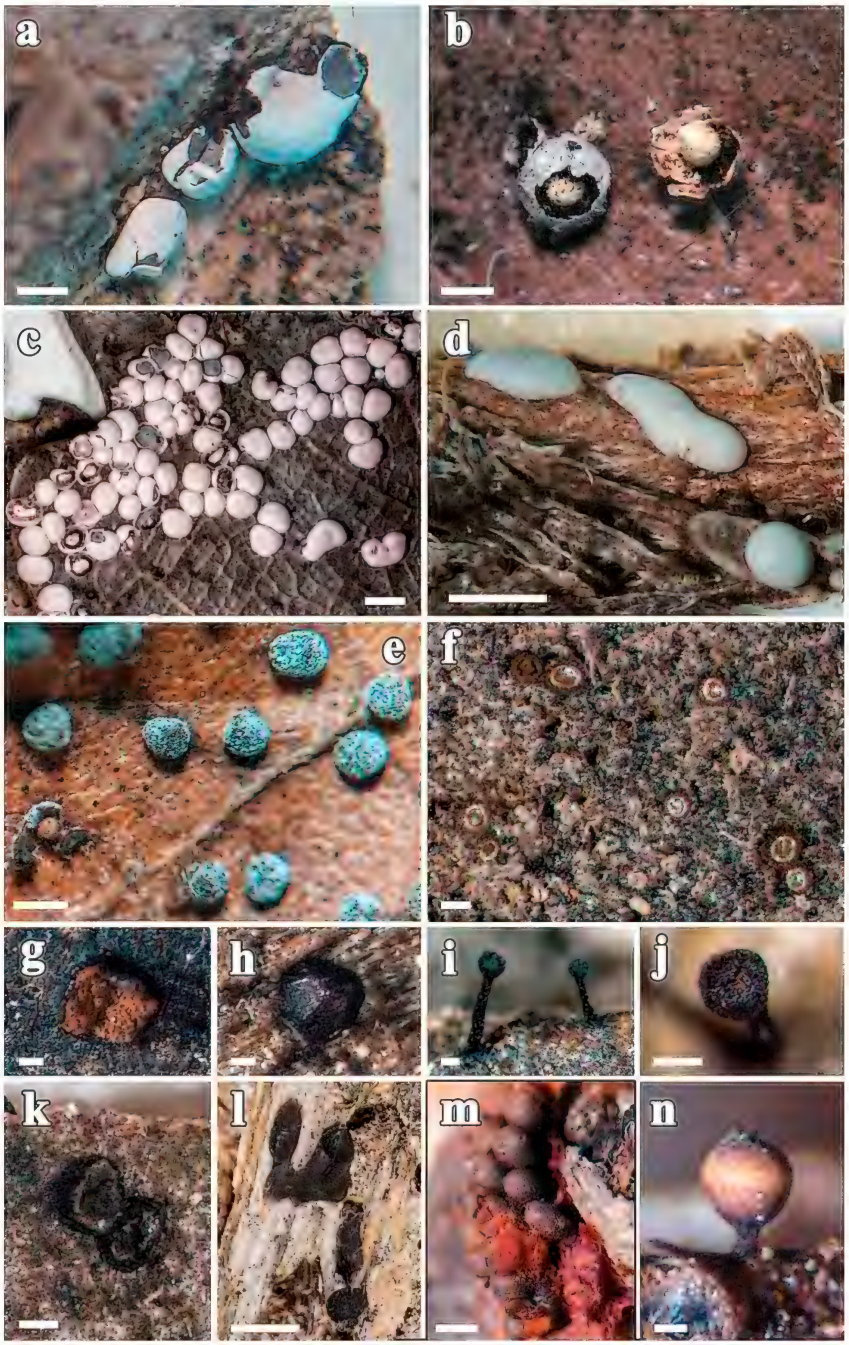
Specimen examined: **UKRAINE**, **Crimea**, **Crimean Nature Reserve**, Central forestry, cordon Bukovskiy, 1000 m, beech forest, wood of *Fagus sylvatica*, 10-VII-2001, leg. K.O. Romanenko fc-141 [as *Metatrichia horrida*] (AH 45918).

Remarks—*Metatrichia horrida* Ing is a similar species with threads also spirally arranged within the sporotheca, but its elaters have more abundant and longer (3–5 µm) spines (Moreno et al. 1997).

Perichaena pedata (Lister & G. Lister) Lister ex E. Jahn, Ber. Deutsch. Bot. Ges. 36: 667 (1919) Fig. 3n

Sporocarps stalked, 0.1–0.3 mm high overall. Peridium dark brown. Stalk well developed, darkish, cylindrical, the same height as the sporothecal

Fig. 3. Sporophores. a. ***Diderma effusum***; b. ***Diderma montanum***; c. ***Diderma testaceum***; d. ***Didymium difforme***; e. ***Didymium minus***; f. ***Licea kleistobolus***; g, h. ***Licea minima***; i, j. ***Licea operculata***; k. ***Licea parasitica***; l. ***Licea variabilis***; m. ***Metatrichia vesparium***; n. ***Perichaena pedata***. Scale bars: a–d, l, m = 1 mm; e = 0.5 mm; f–k, n = 0.1 mm.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diameter. Capillitium yellow, formed by branched filaments ornamented with warts and short spines. Spores 9–10 µm diam., globose to subglobose, yellowish in transmitted light, warted.

Specimen examined: **UKRAINE, Crimea, Crimean Nature Reserve**, Central forestry, cordon Uzen-Bash, 800 m, beech forest, on fallen leaves and nutlets of *Fagus sylvatica*, 23-IX-2000, leg. K.O. Romanenko mc-237 [as *Hemitrichia minor*] (AH 45919).

Remarks—Although widely distributed in the northern hemisphere (http://discoverlife.org), *Perichaena pedata* was not previously recorded from Crimea.

Physarum cinereum (Batsch) Pers., Neues Mag. Bot. 1: 89 (1794)

Sporocarps abundant, sessile. Peridium double, covered with white calcium carbonate granules. Capillitium composed of branching hyaline threads, with small, white, subglobose to fusiform nodes, sometimes fused in the sporocarp center, thus forming a variably sized pseudocolumella. Spores 8–9 µm diam., globose to subglobose, violet-brown, verrucose.

Specimen examined: **UKRAINE, Crimea, Crimean Nature Reserve**, Central forestry, the mountain ridge Sinap-Dag, 900 m, beech forest, leaf litter of *Fagus sylvatica*, 15-VII-2001, leg. K.O. Romanenko fc-302 (AH 45921).

Fig. 4. ***Physarum hongkongense.***
a. Sessile sporocarps; b. Detail of capillitium; c. Spore ornamentation.
Scale bars: a,b = 1 µm; c = 2 µm.

Physarum hongkongense Chao H. Chung, Slime Moulds Hong Kong: 19 (1997)
Fig 4

Sporophores: sessile sporocarps or short plasmodiocarps, sinuous, strongly compressed laterally. Dehiscing along a pre-formed fissure at the top of the sporocarp. Peridium double, with outer layer limy, bright yellow or brown-yellowish and inner layer membranous, hyaline, iridescent. Capillitium reticulate, very abundant, formed by hyaline tubes with numerous, whitish, fusiform or subglobose nodes. Spores 8–9 µm diam., globose to subglobose, violet-brown, minutely warted.

Specimen examined: **UKRAINE**, **Crimea**, **Crimean Nature Reserve**, Bakhchysarai forestry, cordon Ammonalniy, 700 m, hornbeam forest, leaf litter of *Carpinus betulus*, 19-VII-2001, leg. K.O. Romanenko fc-299 [as *Physarum bivalve*] (AH 45920).

Remarks—*Physarum bogoriense* Racib. is a related species that differs from *Ph. hongkongense* morphologically by the shape of the sporocarps, which are not flattened laterally, and the apical dehiscence in irregular recurved lobes. We have not observed remarkable microscopic differences between the two species (spore measures and shape and colour of the capillitium). *Physarum bivalve* Pers. is also similar to *Ph. hongkongense* but differs by its white or pale brown peridium.

Physarum hongkongense is generally rare and recorded in relatively few locations in Canada, Cyprus, France, Japan, New Zealand, Puerto Rico, Spain, Taiwan, Thailand, and USA (http://discoverlife.org). Our record is new for the Ukraine.

Reticularia jurana Meyl., Bull. Soc. Vaud. Sci. Nat. 44: 297 (1908)

Aethalium pulvinate, 2.5–25 mm diam. Cortex membranous, reddish-brown, covered by reticulate pattern. Pseudocapillitium formed by thin (1–2 μm diam.) branched filaments, smooth, reddish-brown, forming a closed network. Spores 6–8 μm diam., globose to subglobose, light brown; one half of the spore surface is reticulate, while the rest is smooth.

Specimen examined: **UKRAINE**, **Crimea**, **Crimean Nature Reserve**, Izobilniy forestry, cordon Asport, 700 m, durmast forests, wood of *Quercus petraea*, 25-IX-2001, leg. K.O. Romanenko fc-380 (AH 45922).

Remarks—The SEM examination reveals that one half of the spore is ornamented by a reticulum of 8–12 angular to hexagonal meshes with solid, unperforated walls, while the other hemisphere is smooth or only faintly ornamented (Moreno et al. 2013).

Stemonitis flavogenita E. Jahn, Verh. Bot. Ver. Prov. Brandenb. 45: 165 (1904)

Sporocarps stipitate, sporotheca violaceous-brown, cylindrical, ≤6.5 mm high overall. Stalk blackish, hollow, horny, 2.5 mm tall. Columella spreading throughout the sporotheca and ending in an apical funnel. Capillitium comprising an outer peridial network (with small meshes) and an internal net (with very wide meshes). Spores 6–7.7 μm diam., globose to subglobose, brown violet in transmitted light, slightly spinulose.

Specimens examined: **UKRAINE**, **Crimea**, **Crimean Nature Reserve**, Izobilniy forestry, cordon Taryer, 600 m, oak–maple forest, wood of deciduous tree, 28-IX-2000, leg. K.O. Romanenko fc-89 (AH 45923); Bakhchysarai forestry, cordon Zubrovaya

Polyana, 450 m, oak–maple forest, wood of *Carpinus betulus*, 30-IX-2001, leg. K.O. Romanenko fc-419 (AH 45924).

Remarks—The spore ornamentation of *Stemonitis flavogenita* is very similar to *S. splendens* Rostaf., which is distinguished by the absence of a columella funnel and an outer surface net with very large meshes. A photograph of sporocarps and detail of the columella of material from Chihuahua (Mexico) can be found in Salazar-Marquez et al. (2014).

Stemonitis herbatica Peck, Ann. Rep. N.Y. St. Mus. Nat. Hist. 26: 75 (1874)

Sporocarps stipitate, 5–6 mm tall overall. Stalk blackish, hollow, horny, 1.5–2 mm high. Capillitium formed by a surface net and internal branches with wide angular nodes. Spores 7–8 µm diam., globose to subglobose, pale violaceous, ornamented by small warts.

Specimen examined: **UKRAINE**, **Crimea**, **Crimean Nature Reserve**, Central forestry, the hill Big Chuchel, 900 m, beech forest, leaf litter of *Fagus sylvatica*, 13-VII-2001, leg. K.O. Romanenko fc-282 (AH 45925).

Symphytocarpus amaurochaetoides Nann.-Bremek., Proc. K. Ned. Akad. Wetensch., Ser. C, 70: 220 (1967) Figs 2m–o

Sporocarps stipitate, violet-blackish, clustered, forming a pseudoaethalium. Stalk conspicuous, black, expanding into a well-developed columella that extends to the sporothecal apex. Capillitium dark, smooth, with no surface net, although sometimes ends of threads join to form small teeth. Spores 6–8 µm diam., globose to subglobose, brown-violaceous, with a faint and incomplete reticulum (similar to spore ornamentation of *Stemonitis fusca* Roth). SEM examination reveals an ornamentation formed by perforated walls, with a few pillars raising the walls above the surface of the spore.

Specimen examined: **UKRAINE**, **Crimea**, **Crimean Nature Reserve**, Bakhchysarai forestry, cordon Zubrovaya Polyana, 450 m, alder–maple forest, dead wood of *Acer campestre*, 19-VII-2001, leg. K.O. Romanenko fc-277 (AH 45926).

Remarks—A rather rare species, known mostly from Europe (http://discoverlife.org).

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Amanita alpinicola sp. nov., associated with *Pinus albicaulis,* a western 5-needle pine

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Abstract—A new species, *Amanita alpinicola*, is proposed for specimens fruiting under high elevation pines in Montana, conspecific with specimens from Idaho previously described under the invalid name, "*Amanita alpina* A.H. Sm., nom. prov." Montana specimens originated from five-needle whitebark pine (*Pinus albicaulis*) forests where they fruit in late spring to early summer soon after snow melt; sporocarps are found mostly half-buried in soil. The pileus is cream to pale yellow with innate patches of volval tissue, the annulus is sporadic, and the volva is present as a tidy cup situated below ragged tissue on the stipe. Analysis of the ITS region places the new species in *A.* sect *Amanita* and separates it from *A. gemmata, A. pantherina, A. aprica,* and the *A. muscaria* group; it is closest to the *A. muscaria* group.

Key words—*Amanitaceae,* ectomycorrhizal, ITS sequences, stone pine, taxonomy

Introduction

In 1954, mycologist Alexander H. Smith informally described an *Amanita* species from the mountains of western Idaho [see Addendum on p. 676]. He gave it the provisional name *Amanita "alpina",* and this name has been used by subsequent collectors of this fungus in Washington, Idaho, and Montana. The taxon is included in Tulloss's key (2008) as "*Amanita alpina* A.H. Sm. *nom. prov.*", and more informally in a key to *Amanita* in the Pacific Northwest (Lindgren 2014). We examined Smith's notes (1954) and exsiccati for herbarium collections A.H. Smith 45357 and 44902 in MICH (Thiers 2014). In these notes, Smith described a pale yellow to whitish *Amanita* that fruits almost entirely

under the duff. The collection information states that it was associated with "*Pinus flexicaulis*" at high elevations; however this is not a valid name for a tree species. He most likely meant *P. albicaulis* Engelm. (whitebark pine) and not *P. flexilis* James (limber pine), because *P. albicaulis* occurs at high elevations in the Seven Devils Mountains (Arno 2001), the original location of one Smith collection. Both pine species are in *P.* subsect. *Strobus* (Hao et al. 2015), and they host some of the same species of ectomycorrhizal fungi (Mohatt et al. 2008, Cripps & Antibus 2011).

Recent collections of a pale yellow *Amanita* found under *P. albicaulis* at high elevations (2500–3000 m asl) in Montana fit Smith's description morphologically and ecologically. Similarly to Smith's fungus, basidiocarps of the Montana fungus also occur almost totally below the soil surface, and as Smith remarked, the fungus appears to "shed its spores while completely subterranean." In addition, the presence of a thin, fragile ring is sporadic or as stated by Smith "the annulus does not form in about half of the basidiocarps." While there have been other reports of this taxon from Washington and Idaho, most do not appear to have been vouchered, photographed, or described while fresh, so we are limiting our observations to those specimens with complete information. Typically such collections have been called "*A. alpina*" or relegated to the *A. gemmata* sensu lato group because of the slight yellowish coloration of the pileus.

The epithet "*alpina*" cannot be validated for this species, because it is now occupied for one of the white alpine amanitas (Cripps & Horak 2010), *Amanita alpina* Contu (Contu 1997), occurring with dwarf *Salix* from the European Alps and neotypified by a P.-G. Jamoni specimen (CAG, Jamoni 702/90). Therefore we formally propose the western North American taxon as *Amanita alpinicola*, combining Smith's provisional name epithet with its treeline-dwelling nature.

Materials & methods

Specimens from Montana were described and photographed while fresh from the field. Vouchers were dried on a dehydrator and deposited in MONT (Thiers 2014). Smith specimens from MICH were examined in the dried state and his herbarium description used for comparison with Montana collections.

The methods for microscopic observations follow those of Tulloss et al. (1992) and Tulloss & Lindgren (2005) where appropriate. In general, the length and width of 25 spores per one basidiocarp in each collection were measured and ranges determined for both spore length and width; averages were calculated for spore length and width. The length/width (Q) ratio was determined for each spore and the ratio range and average (Q_{av}) computed. All measurements were made in 3% KOH at 1000× and drawings were done using a Leica DMSL microscope.

DNA was extracted from ground, dried sporocarp tissue using the DNeasy Plant Mini Kit (Qiagen) following the manufacturer's instructions. PCR amplification of the ITS region was performed using primers ITS1-F and ITS4 (White et al. 1990, Gardes & Bruns 1993) (Integrated DNA technologies). The PCR reaction mix consisted of 9.5 µL sterile double distilled H_2O, 1 µL ITS1-F (10µM), 1 µL ITS4 (10 µM), 12.5 µL REDtaq ReadyMix (Sigma-Aldrich), and 1 µL template DNA. The thermocycler program used was 94°C for 2 min., followed by 30 cycles of 94°C for 30 sec., 55°C for 1 min., and 72°C for 1 min.; followed by a final elongation step of 72°C for 5 min. PCR products were purified using the QIAquick PCR Purification Kit (Qiagen) following the manufacturer's instructions. PCR products were sequenced on both strands with the same primers used in PCR. DNA sequencing was performed at the Berkeley Sequencing Facility (http://mcb.berkeley.edu/barker/dnaseq/home). Consensus sequences of forward and reverse primed sequences were generated using SeqTrace v 0.8.1 (Stucky 2012).

ITS sequences from taxa of *Amanita* sections of interest were obtained from the *Amanitaceae* genetic sequence collection at Amanitaceae.org (http://www.amanitaceae.org/?Amanitaceae+genetic+sequence+collection) which provides links to reliably identified sequences housed on GenBank (some of the taxon names presented on Amanitaceae.org differ from those reported on GenBank). Most sequences of interest that could not be obtained through this site were found in Oda et al. (2002, 2004), Geml et al. (2008), or were obtained from the UNITE database (Kõljalg et al. 2013). Furthermore, the ITS sequence of *A. alpinicola* (CLC 2376, holotype) was subjected to BLAST queries on GenBank and UNITE to check for identical or similar sequences; greater than 97% similar sequences and the closest matching sequence (identified as *A. gemmata* (Fr.) Bertill. from North America) were downloaded. *Amanita pseudoporphyria* Hongo (*A.* sect. *Phalloideae*) was selected as outgroup as in Oda et al. (2004). GenBank accessions for sequences are provided (Table 1).

Multiple sequence alignment was performed using MUSCLE (Edgar 2004) under default settings and the alignment was manually edited using SeAl: Sequence Alignment Editor (Rambaut 1995). Phylogenetic analysis was carried out using PAUP* 4.0b10 (Swofford 2001) under the maximum parsimony (MP) criterion using heuristic searches including 100 random addition sequence replicates, and tree bisection reconnection branch swapping. Clade support was assessed with 1000 bootstrap replicates using heuristic searches, tree bisection reconnection branch swapping, and one random addition sequence per replicate. One representative most-parsimonious tree was randomly selected and the program TreeGraph 2 (Stöver & Müller 2010) was used to draw and edit the resulting tree.

Results

The phylogenetic analysis included 27 taxa with an ITS alignment length of 714 characters; 74 characters were excluded for a final alignment length of 640 characters, of which 495 were constant, 90 were variable but parsimony-uninformative, and 55 were parsimony-informative. The MP analysis resulted in 4001 most-parsimonious trees of 189 steps, consistency index

TABLE 1. *Amanita* specimens and GenBank/UNITE accession numbers of nrDNA ITS sequences used in the phylogenetic analysis

(newly generated sequences in bold)

TAXON	VOUCHER	LOCATION	ITS SEQUENCE
A. alpinicola	CLC 2376 (MONT) [HT]	Montana, USA	**KR152655**
	CLC 2355 (MONT)	Montana, USA	**KR152656**
A. aprica *	RET 128-5 (RET) [IT]	Washington, USA	KF561972
	RET 534-7 (RET) [IT]	California, USA	KF561973
A. gemmata	F19752 (UBC)	B.C., Canada	HQ604823
	JV96-288 (C)	Denmark	UDB002326
	C29013 (C)	Denmark	UDB002325
A. ibotengutake	FB-30968 (CBM) [PT]	Japan	AB080987
	FB-30969 (CBM)	Japan	AB080988
A. muscaria *	RET 143-5 (RET)	Russia	EU071915
	RET 152-6 (RET)	Germany	EU071897
	GAL 4810 (ALA)	Alaska, USA	EU071937
A. muscaria subsp. *flavivolvata* *	CMP 3143 (RET)	Arizona, USA	EU071889
	CMP 1345 (RET)	Arizona, USA	EU071902
A. muscaria var. *alba*	HDT49100 (SFSU)	Idaho, USA	AB080793
A. muscaria var. *formosa*	HDT45060 (SFSU)	California, USA	AB080795
	HDT44761 (SFSU)	California, USA	AB080794
A. muscaria var. *guessowii* *	RET 124-2 (RET)	Massachusetts, USA	EU071896
	RET 271-2 (RET)	New Jersey, USA	EU071899
A. muscaria var. *persicina* *	RET 112-5 (RET) [PT]	Mississippi, USA	EU071887
	RET 151-4 (RET) [PT]	Alabama, USA	EU071892
A. pantherina	M-61495 (K)	England, UK	AB096046
	M-31408 (K)	England, UK	AB080774
A. pseudoporphyria (outgroup)	FB-30951 (CBM)	Japan	AB015702
A. regalis *	506 (O)	Norway	AB080780
	1539 (O)	Norway	AB080781
Environmental sample	—	California, USA	AY702732

Herbarium acronyms follow Thiers (2014), except for RET (Herbarium Amanitarum Rooseveltensis, New Jersey, U.S.A.)

*Accessed via the *Amanitaceae* genetic sequence collection at http://www.amanitaceae.org/ [2015]; some taxon names differ from those reported on GenBank.

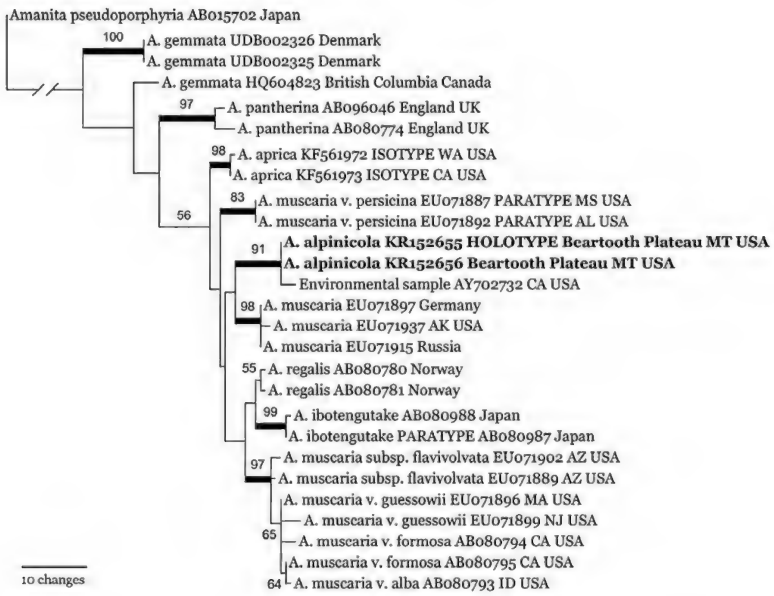
Amanita pseudoporphyria AB015702 Japan
100
A. gemmata UDB002326 Denmark
A. gemmata UDB002325 Denmark
A. gemmata HQ604823 British Columbia Canada
97
A. pantherina AB096046 England UK
A. pantherina AB080774 England UK
98
A. aprica KF561972 ISOTYPE WA USA
A. aprica KF561973 ISOTYPE CA USA
83
A. muscaria v. persicina EU071887 PARATYPE MS USA
56
A. muscaria v. persicina EU071892 PARATYPE AL USA
91
A. alpinicola KR152655 HOLOTYPE Beartooth Plateau MT USA
A. alpinicola KR152656 Beartooth Plateau MT USA
Environmental sample AY702732 CA USA
98
A. muscaria EU071897 Germany
A. muscaria EU071937 AK USA
A. muscaria EU071915 Russia
55
A. regalis AB080780 Norway
A. regalis AB080781 Norway
99
A. ibotengutake AB080988 Japan
A. ibotengutake PARATYPE AB080987 Japan
97
A. muscaria subsp. flavivolvata EU071902 AZ USA
A. muscaria subsp. flavivolvata EU071889 AZ USA
A. muscaria v. guessowii EU071896 MA USA
A. muscaria v. guessowii EU071899 NJ USA
65
A. muscaria v. formosa AB080794 CA USA
A. muscaria v. formosa AB080795 CA USA
64
A. muscaria v. alba AB080793 ID USA
10 changes

FIG. 1. One most-parsimonious tree of nrDNA ITS sequence data. Bootstrap values are indicated above or below branches leading to clades receiving ≥50% support. Thickened branches lead to clades receiving ≥75% support. Collections of *A. alpinicola* are indicated in bold type.

(CI) = 0.8571, retention index (RI) = 0.8457 and rescaled consistency index (RC) = 0.7249. Morphological and ITS sequence similarity between *Amanita alpinicola* and representative samples of *A.* sect. *Amanita* (*A. pantherina* (DC.) Krombh., *A. gemmata, A. aprica* J. Lindgr. & Tulloss, *A. regalis* (Fr.) Michael, *A. ibotengutake* T. Oda et al., and the *A. muscaria* group) suggest *A. alpinicola* belongs to *A.* sect. *Amanita* Corner and Bas.

Phylogenetically, it is clearly separated from other taxa (FIG. 1) and is described here as a new species; sequences are deposited in GenBank (KR152655, KR152656). Amplification of the ITS region was unsuccessful for Smith's collections.

Taxonomy

Amanita alpinicola C. Cripps & J. Lindgr., **sp. nov.** FIGS 2, 3

MYCOBANK MB 812991

Differs from *Amanita muscaria, A. muscaria* var. *persicina, A. muscaria* var. *guessowii*, and *A. muscaria* var. *formosa* by its thin, fragile annulus (often ephemeral and sometimes absent) and its thick, rimmed cupulate volva.

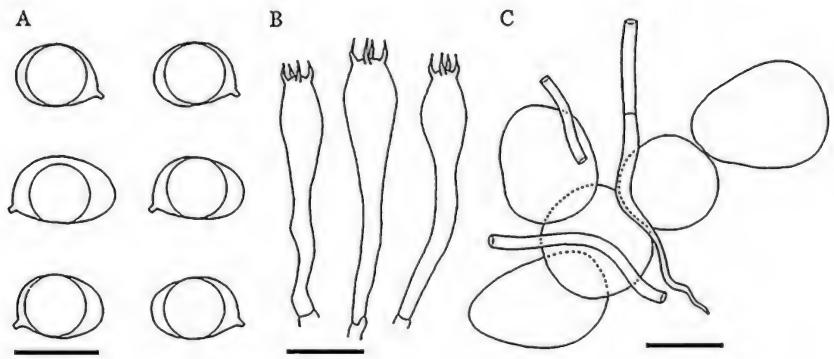

Fig. 2. *Amanita alpinicola* (holotype, CLC 2376). A. basidiospores; B. basidia; C. elements of universal veil from pileus. Scale bars: A = 10 µm; B, C = 20 µm. Drawings by E.G. Barge.

Type: USA. Montana. Carbon County: near Red Lodge, Beartooth Pass overlook, ca 2500 m asl, under *Pinus albicaulis* Engelm., 8.VIII.2008, leg. C. Cripps CLC 2376 (**Holotype,** MONT; GenBank KR152655).

Etymology: *alpinicola,* for Smith's original provisional epithet and the high elevation habitat.

Pileus 4–9 cm in diameter, convex, broadly convex, expanding to almost plane, dingy white to very pale yellow but more buff when dry, greasy or thinly viscid, covered with fine, raised dingy white to whitish tan warts from the universal veil that are somewhat integrated into the pileipellis; warts in a polygonal pattern or scattered, completely covering the pileus at first, then thinning as weathered; surface often dirty with adhering soil; margin turned down or not, indistinctly striate for a few mm or not; Lamellae free, crowded (N ≈200 or more), well separated with a few short lamellulae or not, rounded out, rather broad, white to cream, sticky; edges floccose, white; Annulus white, thin, fragile, often as a band of tissue, easily disappearing or none (exannulate form), often with torn/ragged tissue in zones on lower stipe; Stipe 5–10(–18) × 1–3 cm, equal, narrower in the middle or gradually enlarging towards base, rounding out and then often with a point at very base, white, floccose above and fibrillose below, often with torn tissue; Volva as a tidy cup, rather thick, rimmed (or with several

Fig. 3. *Amanita alpinicola.* Habit: A (CLC 2118), B (holotype, CLC 2376), C (CLC 2255). Showing subterranean fruiting habit in *Pinus albicaulis* forests: D (CLC 1994). Photos by C. Cripps.

A
B
C
D

'rims' in layers), dirty white, persistent, tough, often covered with adhering soil; CONTEXT white, stem partially stuffed; Odor indistinct or unpleasant to slightly fruity; EXSICCATI COLORS pale orange pileus, pale (but darker than pileus) orange lamellae, and dingy cream stipe; context dingy cream with some pale orange; volva darker and covered with soil.

UNIVERSAL VEIL on pileus consisting of plentiful inflated cells (in some areas with only inflated cells); inflated cells integrated into subtending filamentous hyphae of pileipellis; inflated cells globose, slightly elliptical or clavate, (35–)50–75(–100) µm diam.; walls thin to somewhat thickened, hyaline. Volva tissue also consisting of inflated cells, but typically more clavate than globose and also containing pale (yellowish) oleiferous hyphae ≤12 µm diam. No clamps observed; PILEIPELLIS in cross-section, without gelatinous layer, a cutis of tightly interwoven filamentous cells, 7–10 µm diam., some with diffuse yellow pigment or yellow refractive material; some hyphae slightly swollen and existing as elliptical cells ≤24 µm wide; lower hyphal layer more parallel. No clamps observed; PARTIAL VEIL a mix of filamentous and clavate cells, 4–8(–10) µm diam., sometimes with a few clavate cells connected in succession, in areas with yellow pigment; walls thin, smooth; oleiferous hyphae scattered, ≤7–20 µm diam. No clamps observed; LAMELLAR TRAMA divergent, of inflated hyphae. SUB-HYMENIUM a basement layer several cells thick of cellular thin-walled cells, irregular-squarrose, 10–15(–20) µm diam. BASIDIA 49–70 × 7–14 µm, clavate, 4-spored; sterigmata ≤7 × 1.5 µm; clamps infrequent; BASIDIOSPORES (holotype, CLC 2376) white in deposit, 9–12 × 7–8 µm, average 10.5 × 7.8 µm, Q range 1.25–1.5, Q_{av} = 1.4, hyaline, thin-walled, ellipsoid, smooth, non-amyloid, 1-guttulate; apiculus sublateral.

HABIT, HABITAT & DISTRIBUTION—In subalpine to tree-line zones with five-needle pines. Reported from Montana, Idaho, and known from a few places in the Pacific Northwest. Phylogenetic placement of the ITS sequence isolated from a root tip in a conifer forest in the Sierra Nevada of California also suggests its presence there (Izzo et al. 2005). The fully opened fruiting bodies are often found buried in the soil in these high, dry habitats. Ectomycorrhizal with five-needle western pines including at least *Pinus albicaulis* and possibly *P. monticola*, and also with three-needle *P. jeffreyi*. Fruiting can begin 'early' in the season shortly after the snowbank fungi decline, but 'early' is a relative term and typically ranges from July to mid-August at these high elevations (2500–3000 m), and it can also be found later in the year. It also occurs in May in Washington and Idaho.

Additional specimens examined—**UNITED STATES. Idaho. Valley County**: Upper Payette Lake, Twenty mile Creek, reported with lodgepole pine [but *P. albicaulis* is in the vicinity], 13.VII.1954, leg. A.H. Smith AHS44902 (MICH); **Idaho County**: Seven Devils Mts., Heaven's Gate, scattered under "*Pinus flexicaulis*" at high elevations, 26.VII.1954, leg. Bigelow & Smith AHS45357 (MICH). **Montana. Park County**: near Cooke City, Fisher Creek drainage, ca 3000 m asl, under *Pinus albicaulis*, 1.VII.2004, leg. C. Cripps CLC 1994 (MONT); 12.VII.2005, CLC 2118 (MONT); 20.VII.2005, leg. C. Cripps CLC 2169 (MONT); Miller Creek drainage, ca 3000 m asl, under *P. albicaulis*, 7.VIII.2009, leg. C. Cripps CLC 2456 (MONT); **Carbon County**: near Red Lodge, Beartooth Pass overlook, ca 2500 m asl, under *P. albicaulis*, 24.VII.2008, leg. C. Cripps CLC 2355 (MONT; GenBank KR152656); **Gallatin County**: Bear Canyon, near Fridley burn, in pure unburned *P. albicaulis*, 22.VI.2006, leg. C. Cripps CLC 2235b (MONT); Sacajawea Saddle, 2700 m asl, under *P. albicaulis*, 16.VIII.2005, leg. K. Mohatt KRM 002 (MONT).

Discussion

The name *Amanita gemmata* has been used to delineate what appears to be a group of yellow *Amanita* species in *A.* sect. *Amanita* in western North America, more particularly in the Pacific Northwest, Idaho, Montana, and Canada. The use of this European name for North American collections is considered a misapplication (Tulloss et al. 1995, Lindgren 2014, Zhang et al. 2004, Tulloss 2010) and this leaves some of our taxa unnamed. In comparison with *A. alpinicola*, the pileus of *A. gemmata* is deeper yellow, the universal veil tissue on the pileus is easily removed and not innate, the habit is not subterranean, and it is not reported with five-needle pines. *Amanita aprica* has been formally separated out of the *A. gemmata* group (Tulloss & Lindgren 2005). It is a bright orange-yellow spring species reported from Washington, Oregon, northern California, and British Columbia, primarily with Douglas fir (*Pseudotsuga menziesii*) and lodgepole pine (*Pinus contorta*).

The status of the yellow *Amanita muscaria* var. *formosa* Pers. and *A. muscaria* var. *guessowii* Veselý is less clear. But a yellow taxon that has gone under these names does occur in at least Montana, Idaho, Washington, and Oregon. Like *A. muscaria* (L.) Lam. var. *muscaria*, it has the quintessential rings of volval tissue at the base of the stipe and yellow color under the pileipellis. The bright red *A. muscaria* subsp. *flavivolvata* Singer occurs in Alaska south throughout the Pacific Northwest, and again in the southern Rocky Mountains, but is apparently absent from Alberta, Montana, and Idaho where the yellow variety appears with conifers and aspen. *Amanita alpinicola* is separated from these taxa by both morphological and molecular differences. In addition, the ecology is different and *A. alpinicola* appears to be specific for five-needle pines, primarily whitebark pine (*P. albicaulis*), often fruiting just below the soil surface in the open understory.

The Montana collections clearly match Smith's provisional taxon in macro- and micromorphology, although the lamellae in the Smith exsiccati are darker orange as is typical for older specimens. Smith suggested that his species might be a "satellite" species to *A. muscaria* and the molecular analysis does suggest the placement of this new species in *A.* sect. *Amanita*. Studies of this group have suggested that the presence or absence of clamps at the base of the basidia may be an important micro-morphological feature (Tulloss, pers. comm.) and here we report rare, thin clamps at the base of the basidia of *A. alpinicola*.

A mycorrhizal specificity for five-needle pines is likely for this *Amanita* species, and several *Suillus* share this ecology in western North America (Mohatt et al. 2008, Cripps & Antibus 2011). Other amanitas with a near subterranean habit appear in Australia in sandy soil under dry climatic conditions (Miller 1991), but they are in sections other than *A.* sect. *Amanita*. There is one report of poisoning for *A. alpinicola* (Beug 2016) and it is closely related to other amanitas, such as *A. muscaria*, which contain ibotenic acid and muscimol. Thus, it is likely that *A. alpinicola* is toxic and future assays may reveal the presence of these compounds.

Acknowledgments

We wish to thank Rod Tulloss for providing information on related *Amanita* species. The University of Michigan Herbarium is acknowledged for providing Smith's collections, and Michael Beug and Steve Trudell are thanked for editorial comments, and the Nomenclature Editor Shaun Pennycook for review.

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Addendum—Smith's original description for *Amanita* "*alpina*" (A.H. Smith 44902 and 45357) "Pileus 3–9 cm broad, convex expanding to plane or nearly so, surface thinly viscid beneath poorly formed floccose warts which collapse in age, warts somewhat conic when well-formed and white, cap margin even or rarely short-striate in extreme age, ground color pale yellow to cream color but in age often whitish finally discoloring to brownish; flesh white, unchanging, odor not distinctive, no color changes when bruised. Lamellae white or in age with a creamy tone, broad, close to subdistant. Attached narrowly to the stipe, breaking away in age, not staining when bruised. Stipe 3–9 cm long, 1–2.5 cm thick at apex, with a rounded bulb at the base, a free-margined volva which is not inrolled, above this often occur interrupted zones of partial veil tissue or a true median or superior annulus, or all remains of a partial veil obliterated (about half the specimens). Spores 9–12 × 6–7.5 µm, ellipsoid, smooth, non-amyloid. Basidia 4-spored. Clamp connections present. Scattered under *Pinus flexicaulis* at high elevations, Seven Devils Mts. Idaho, July 26, 1954, Bigelow & Smith 45357.

"Observations. The basidiocarps of this species often do not break through the duff but actually shed their spores while completely subterranean. The annulus does not form in about half the basidiocarps. The species appears to be a satellite to *A. muscaria* – which is an extremely variable species in the Idaho mountains."

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Cladosporium, *Phialophora*, *Pseudoramichloridium* & *Ticogloea* spp. nov. from China

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Abstract—Four new species from soil in China—*Cladosporium ningboense*, *Phialophora dimorphospora*, *Pseudoramichloridium xinjiangense*, and *Ticogloea elliptica*—are described, illustrated, and compared morphologically with similar species. The type specimens (dried cultures) and living cultures are deposited in the Herbarium of Shandong Agricultural University: Plant Pathology (HSAUP).

Key words—anamorphic fungi, morphology, taxonomy

Introduction

Four specimens collected during a survey of soil dematiaceous hyphomycete diversity in China, were found to represent undescribed species in *Cladosporium*, *Phialophora*, *Pseudoramichloridium*, and *Ticogloea*. The morphological characteristics of the fungi are described, illustrated, and compared with similar taxa. Specimens and living cultures are conserved in the Herbarium, Department of Plant Pathology, Shandong Agricultural University, Taian, China (HSAUP).

§ Y.L. Jiang and Y.M. Wu contributed equally to this work.

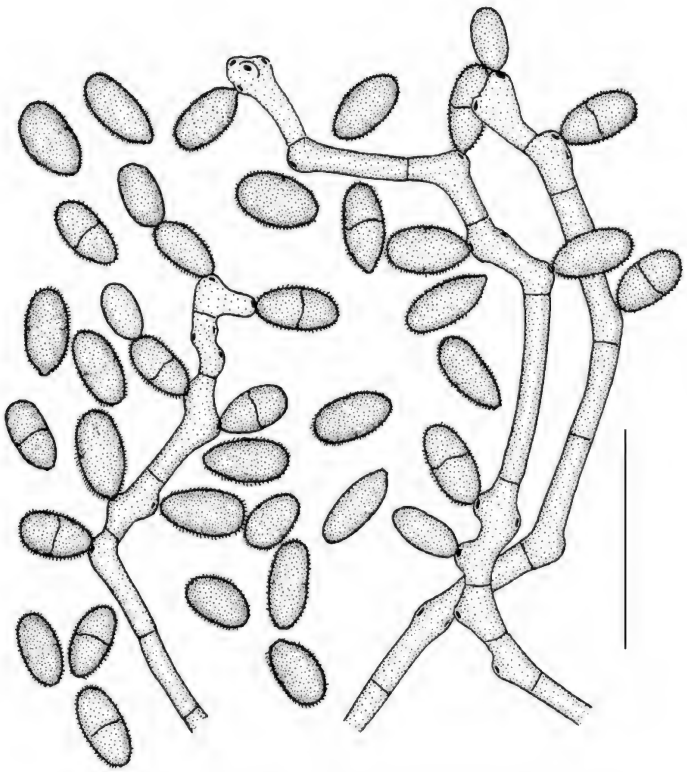

FIG. 1. *Cladosporium ningboense* (ex holotype, HSAUP $II_{04}3120$). Conidia and conidiophores. Scale bar = 25 µm.

Cladosporium ningboense J.J. Xu, Y.M. Wu & T.Y. Zhang, **sp. nov.** FIG. 1

MYCOBANK MB 820628

Differs from *Cladosporium allii* by its much smaller, ellipsoidal or broadly obovate conidia and from *C. qinghaiense* by its wider conidia.

TYPE: China, Zhejiang Province, Ningbo City, from soil of a vegetable plot, August 2004, J.J. Xu (**Holotype**, HSAUP $II_{04}3120$).

ETYMOLOGY: in reference to the city where the specimen was collected.

COLONIES on PDA effuse, velvety or powdery, dark brown or dark greenish brown, growing moderately, reaching a diameter of 3–5.5 cm in 2 weeks at 25 °C. MYCELIUM mostly superficial; hyphae brown, smooth, septate, branched, 2.5–6.5 µm diam. CONIDIOPHORES lateral or terminal, smooth, simple or occasionally branched, cylindrical, sympodial, geniculate and nodulose, <200 µm (sometimes longer), 6–11 µm diam. CONIDIA arising from terminal swellings of conidiophores, which later become intercalary, solitary or

sometimes catenate, ellipsoidal or broadly obovate, finely echinulate, rounded at the apex, tapered to the truncate base, pale brown to dark greenish brown, 0–1-septate, 10–20 × 6.5–12.5 μm, L/W = 1.5 ± 0.1.

Comments: In morphology of the sporogenous apparatus, *Cladosporium ningboense* is close to *C. allii* (Ellis & G. Martin) P.M. Kirk & J.G. Crompton and *C. qinghaiense* T. Zhang & Z.Y. Zhang. *Cladosporium allii* differs by its larger, cylindrical conidia with rounded ends (28–42× 12–16 μm; Kirk & Crompton 1984), and *C. qinghaiense* is distinguished by its narrower conidia (10.8–21.6 × 5.4–9.5 μm, L/W = 2 ± 0.1; Zhang et al. 1998, 2003).

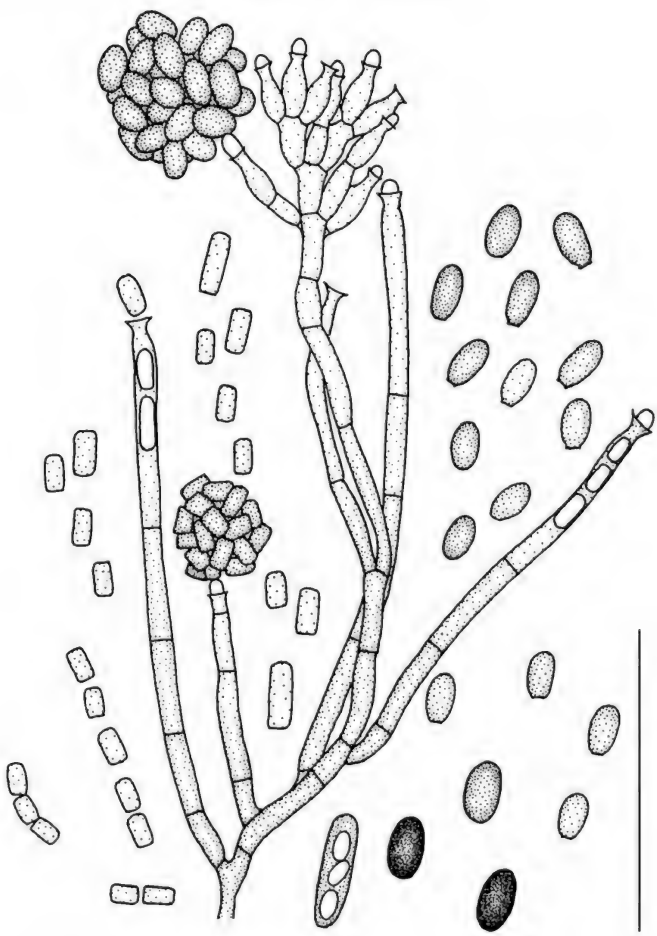

Fig. 2. *Phialophora dimorphospora* (ex holotype, HSAUP $II_{04}2548$). Conidia, conidiophores, and phialides. Scale bar = 25 μm.

Phialophora dimorphospora J.J. Xu & T.Y. Zhang, **sp. nov.** Fig. 2

MycoBank MB 820631

Differs from all other *Phialophora* species by its dimorphic phialides and conidia: (1) penicillately arranged, lageniform phialides producing ellipsoidal to cylindrical conidia with rounded ends; (2) single cylindrical phialides producing oblong conidia with truncated ends.

Type: China, Zhejiang Province, from montane soil of Yandang Mountains, August 2004, J.J. Xu (**Holotype**, HSAUP $II_{04}2548$).

Etymology: in reference to the dimorphic conidia.

Colonies on PDA effuse, velvety, pale brown at first then brown to blackish brown, reverse dark brown to black, slow-growing, reaching a diameter of 1.5–2 cm in 2 weeks at 25 °C. Mycelium mostly superficial; hyphae pale brown to brown, septate, 2–7.5 µm diam., often funiculose. Conidiophores unbranched or occasionally branched, smooth, pale brown to brown, septate, ≤62.5 µm long, 1.5–2.5 µm diam. Phialides and Conidia dimorphic: (1) lageniform terminal phialides arranged penicillately, with conspicuous collarettes, 3.5–7.5 × 1.5–3.5 µm, producing unicellular, ellipsoidal, narrowly ellipsoidal, or cylindrical conidia with rounded ends, or sometimes truncate at the base, pale to dark brown, 4.5–9.5 × 2–3.5 µm, often accumulating at the apex of the phialides in a slimy head; (2) solitary, long cylindrical phialides, pale brown to brown, with deep cupulate collarettes, producing oblong conidia with truncate ends, hyaline to subhyaline, 1.5–6 × 1–2 µm, often accumulating at the apex of the phialides in a slimy head.

Pseudoramichloridium xinjiangense T.Y. Zhang & J.H. Kong, **sp. nov.** Fig. 3

MycoBank MB 820632

Differs from *Pseudoramichloridium henryi* by its longer conidiophores and larger conidia.

Type: China, Xinjiang Uygur Autonomous Region, Aksu, from soil of a park, July 2005, J.H. Kong (**Holotype**, HSAUP II_{052570}).

Etymology: in reference to the region where the specimen was collected.

Colonies on PDA effuse, greyish brown, velvety, growing slow. Mycelium partly superficial, partly immersed; hyphae branched, septate, hyaline to pale brown, smooth, 1.5–2.5 µm diam. Conidiophores macronematous, cylindrical, straight or slightly flexuous, unbranched, brown, smooth, mostly 100–200 µm long (sometimes up to 375 µm long or more), 2.5–3.5 µm diam. Conidiogenous cells terminal or intercalary, subhyaline to pale brown, paler towards the apex, cylindrical, sympodial, 23–74 × 3–4 µm, conidial scars denticulate. Conidia unicellular, narrowly obovate to ellipsoidal, rounded

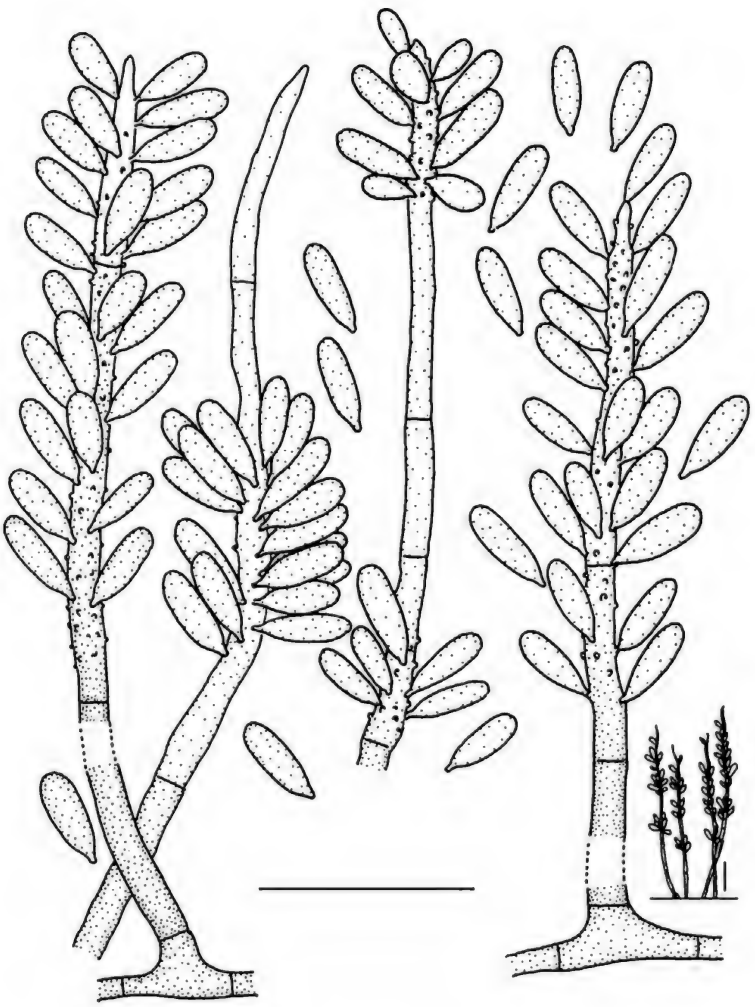

Fig. 3. *Pseudoramichloridium xinjiangense* (ex holotype, HSAUP $II_{05}2570$). Conidia, conidiophores, conidiogenous cells, and denticles. Scale bars = 25 μm.

or obtuse at the apex, tapering towards the truncate base, subhyaline to pale brown, smooth, 7–14.5 × 3–4 μm.

Comments: *Pseudoramichloridium xinjiangense* somewhat resembles *P. henryi* Cheew. & Crous, which differs by its shorter conidiophores (<90 μm long) and smaller conidia (6–8 × 2.5–3 μm; Cheewangkoon et al. 2009).

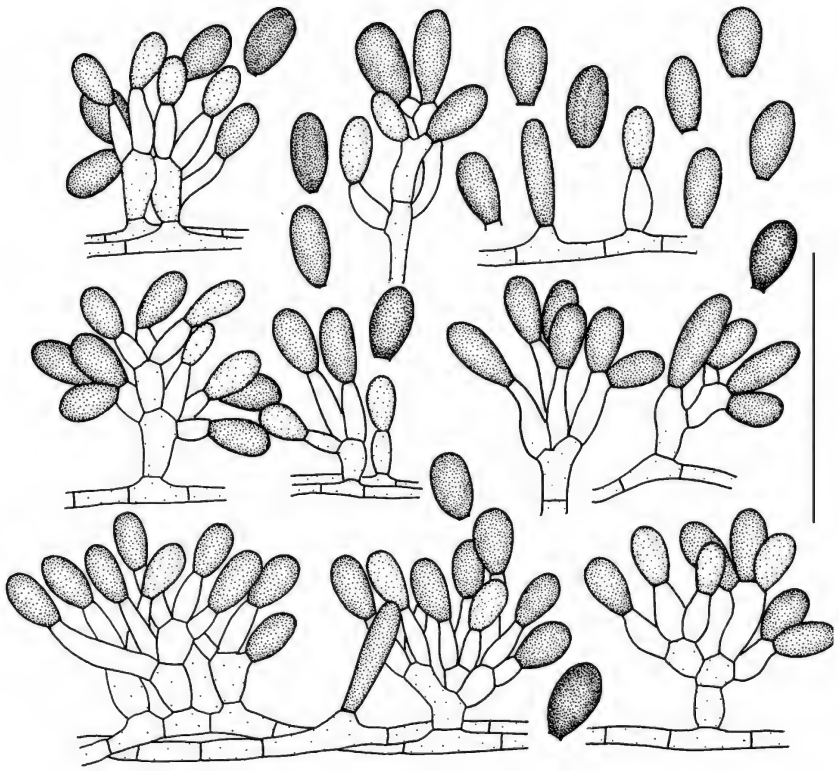

FIG. 4. *Ticogloea elliptica* (ex holotype, HSAUP $II_{04}2817$).
Conidia, conidiophores, and conidiogenous cells. Scale bar = 25 μm.

Ticogloea elliptica T.Y. Zhang, Y.M. Wu & J.J. Xu, **sp. nov.** FIG. 4

MYCOBANK MB 820633

Differs from *Ticogloea guttulata* by its bigger, ellipsoidal or obovate, smooth conidia.

TYPE: China, Zhejiang Province, Hangzhou City, from shore soil of West Lake, August 2004, J.J. Xu (**Holotype**, HSAUP $II_{04}2817$).

ETYMOLOGY: in reference to the shape of the conidia.

COLONIES on PDA effuse, at first greyish white, then gradually becoming grey to dark grey, slightly darker and raised in the middle, velvety or cottony, reverse pale grey to dark greyish brown, growing slow, reaching a diameter of 3–5 cm in 2 weeks at 25 °C. MYCELIUM partly superficial, partly immersed; hyphae hyaline to subhyaline, septate, branched, smooth, 2–3 μm wide. CONIDIOPHORES lateral, septate, branched, hyaline to subhyaline, smooth,

2–19 × 2.5–3.5 µm. Conidiogenous cells cylindrical or subulate, sympodial. Conidia holoblastic, solitary, acropleurogenous, aseptate, ellipsoidal or obovate, smooth, initially hyaline or pale, dark brown when mature, rounded at the apex, slightly truncate at the base, 5–9.5 × 3–5.5 µm.

Comments: There is only one previously described *Ticogloea* species, *T. guttulata* G. Weber et al., which differs from *T. elliptica* by its smaller conidia (3.8–5.0 × 2.7–3.5 µm; Halmschlager & Kowalski 2000) that are guttulate and sometimes roughened (Seifert et al. 2011).

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Phylloporus brunneiceps from Pakistan

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Abstract—The fungal species *Phylloporus brunneiceps* (*Boletaceae, Boletales*) from a pure *Quercus* forest is described and illustrated as a new record for Pakistan. Phylogenetic analyses, description, photographs, and line drawings of the Pakistani collection are provided.

Key words—gilled boletes, ITS, oak, 28S, rDNA

Introduction

Phylloporus Quél. is a gilled bolete represented by the type species *Agaricus pelletieri* Lév. [≡ *P. pelletieri* (Lév.) Quél.] from temperate Europe. The genus encompasses a diverse group characterized by predominantly lamellate instead of poroid hymenophores (Singer 1986, Binder & Bresinsky 2002, Neves & Halling 2010, Neves et al. 2012, Zeng et al. 2013). It forms mycorrhizal associations with members of *Casuarinaceae*, *Dipterocarpaceae*, *Fabaceae* (*Caesalpinioideae*, *Mimosoideae*), *Fagaceae*, *Myrtaceae,* and *Pinaceae* (Heinemann & Rammeloo 1987, Halling & Mueller 2002). The moderately small genus known represented worldwide (Neves & Halling 2010; Neves et al. 2012; Zeng et al. 2013) by 90 species plus several subspecies and varieties (https://www.indexfungorum.com; accessed July 2017).

Phylloporus is regarded as more abundant in Malaysia and Australia, where most species have been described (Corner 1970, 1974; Watling 2008). However, *Phylloporus* and other boletes have not been well studied in many areas, and new records are frequently reported (Li et al. 2011; Zeng et al. 2011, 2013; Hosen & Li 2017).

Only *P. rhodoxanthus* (Schw.) Bres. has been reported from Pakistan, based on morphological evidence (Sultana et al. 2011). We describe a second *Phylloporus* species from Pakistan, *P. brunneiceps,* based on morphological and ITS1-5.8S-ITS2 and 28S rDNA sequence analyses. *Phylloporus brunneiceps* is associated with *Quercus* in moist temperate forests of Pakistan.

Material & methods

Sampling site

The specimen was collected during a field investigation of ectomycorrhizal communities associated with oak forests near Alpurai forest. The collection area, Toa (34°54′N 72°39′E), lies on the boundary of Shangla and Swat districts (KPK province, Pakistan). The region, which ranges in elevation from 850 to 2350 m, is characterized by a very prolonged cold winter, short summer, and annual rainfall of approximately 142 cm.

Morphological analyses

The specimen was photographed in field using a Nikon D70S digital camera. After the odor and color change upon bruising were recorded, the specimen was wrapped in aluminum foil and kept separately in a collection box. Colors were designated with reference to mColorMeter. After being dried by a fan heater, the collection was sealed in plastic and deposited in Lahore Herbarium, Department of Botany, University of the Punjab, Lahore, Pakistan (LAH).

Tissues from lamellae, pileipellis and stipitipellis were mounted in phloxine (1%) for better contrast, Melzer's reagent for amyloid basidiospore ornamentation, and KOH (5%) for colored hyphae and examined using a Meiji Techno MX4300H compound microscope. Measurements were determined for basidiospores, basidia, and other anatomical cells under the light microscope equipped with a camera lucida.

DNA extraction, amplification and sequencing

DNA was extracted from basidiome gills following modified CTAB method (Bruns 1995). PCR amplification was performed with primer pairs ITS1F/ITS4 (White et al. 1990) for the ITS region, and LR0R/LR7 (Vilgalys & Hester 1990) for the 28S region of nuclear ribosomal DNA. PCR conditions for ITS and 28S were as follows: an initial denaturation step at 94°C for 4 min, followed by 34 cycles of 94°C for 40 sec, 55°C (ITS) or 52°C (28S) for 40 sec, and 72°C for 1 min, and a final elongation step at 72°C for 8 min. The PCR products were sent to Macrogen Inc. (Korea) for sequencing. Sequences were submitted to GenBank.

Molecular phylogenetic analyses

The consensus sequences for ITS and 28S were generated from the sequences obtained by both the primers using BioEdit software. GenBank sequences of closely related taxa were used to prepare a ITS and 28S data matrix based on a BLAST

Fig. 1. *Phylloporus brunneiceps* (LAH35203). Basidiomata. Scale bars = 10 mm.

search. The downloaded sequences and newly generated sequences were aligned using MUSCLE v3.6 (Edgar 2004) and manually adjusted where necessary.

The ITS sequences were trimmed with the conserved motifs. The alignment portion between 5′...GAT and CAAA...3′ was included in phylogenetic analysis. Maximum likelihood (ML) analysis was performed using a general time-reversible model (Nei & Kumar 2000) and nearest-neighbor interchange as the ML heuristic search method in MEGA6 software to test the phylogeny at 1000 bootstraps.

Results

Taxonomy

Phylloporus brunneiceps N.K. Zeng, Zhu L. Yang & L.P. Tang, Fung. Divers. 58: 82 (2013) Figs 1,2

Basidiomata medium-sized. Pileus 7.5 cm diam., centrally depressed, surface dry, tomentose, dark brown (9YR 1.5/1.7) in centre, brown (2Y 3.8/3.1) near the margin; margins inrolled. Lamellae ≤0.5 cm high, decurrent, subdistant, bright yellow (5.3Y 6.1/8.9) to yellow (3.7Y 3/5.6), becoming blue when injured before reverting to the original yellow. Lamellulae present, variable in size, in one tier. Stipe 6.5 × 1.2 cm, central, cylindric, solid, dry, tomentose, yellowish white or greenish yellow (1.1GY 7.6/2.9) at base, becoming yellow (7.5Y 7.2/4.8) in middle and bright orange or yellow red (6YR 3.1/7.4) at top. Annulus absent.

Basidiospores [n/b/p = 30/1/1] (10.2–)10.3–13.7(–14) × (3.7–)4.0–4.6 (–4.7) µm, mean = 11.69 × 4.45 µm, Q = (2.13–)2.23–2.97(–3), avQ = 2.85, ellipsoid, smooth, thick-walled, olive brown in KOH, dextrinoid. Basidia 33–43 × 8–9 µm, clavate, thin-walled, 4-spores, sterigmata 4–5 µm in length. Cheilocystidia 30–50 × 11–14 µm, subclavate, thin-walled, light yellow in KOH. Pleurocystidia 69–100 × 10–16 µm, fusiform, thick-walled, light yellow in KOH, abundant. Pileipellis a trichoderm, hyphae 4–10 µm diam., yellowish brown in KOH, rarely branched, end cells obtuse. Stipitipellis a trichoderm-like structure composed of thin-walled hyphae, light yellow in KOH. Clamp connections absent.

Material examined: **PAKISTAN, Khyber Pakhtunkhwa Province, Shangla/ Swat boundary,** Toa, 2100 m asl, solitary on ground under *Quercus incana* Roxb. [= *Q. oblongata* D. Don], 15 July 2015, Arooj Naseer & Abdul Nasir Khalid AST44(LAH35203, GenBank KY679591, KY679592 & KY679593).

Molecular phylogeny

Sequencing of the *P. brunneiceps* PCR products using ITS1F/ITS4 yielded 690 base pairs, trimmed to a 640-base pair consensus sequence. The BLAST

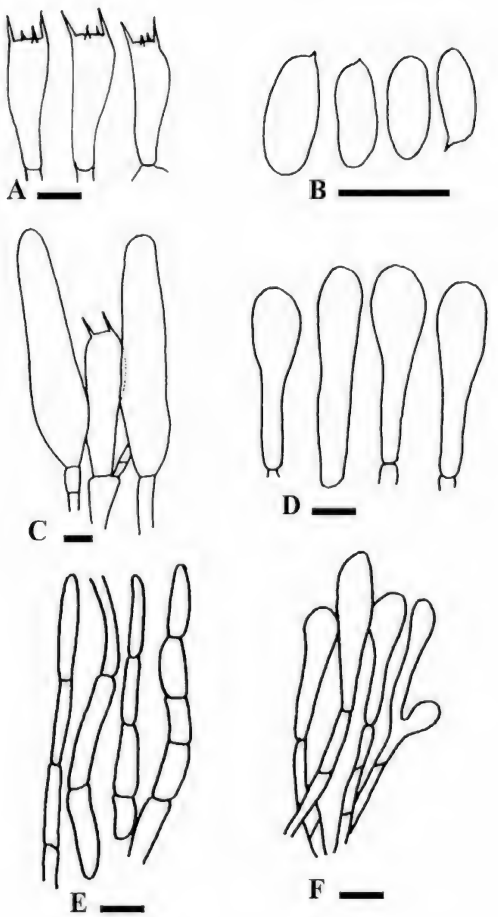

FIG. 2. *Phylloporus brunneiceps* (LAH35203).
A. basidia; B. basidiospores; C. pleurocystidia; D. cheilocystidia; E. pileipelli; F. stipitipellis.
Scale bars = 10 µm.

search revealed LAH35203 as 98% identical with JQ967242, JQ967244, (100% query cover, 0.0 E value) and a 97% identity with KJ609173 and JQ967243 (99% query cover, 0.0 E value).

Sequencing of the *P. brunneiceps* PCR products using LROR/LR5 yielded 840–860 base pairs, trimmed to a 723 base pair consensus sequence. Initial BLAST analysis revealed LAH35203 as 99% identical to JQ967201, NG042664, and JQ967200 (100% query, 0.0 E value).

The sequences were aligned with ITS and 28S sequences of the other related taxa. The final data set included 31 ITS sequences and 30 28S sequences. The analysis clustered the sequences generated during this study with sequences of *P. brunneiceps* from China (Figs 3,4).

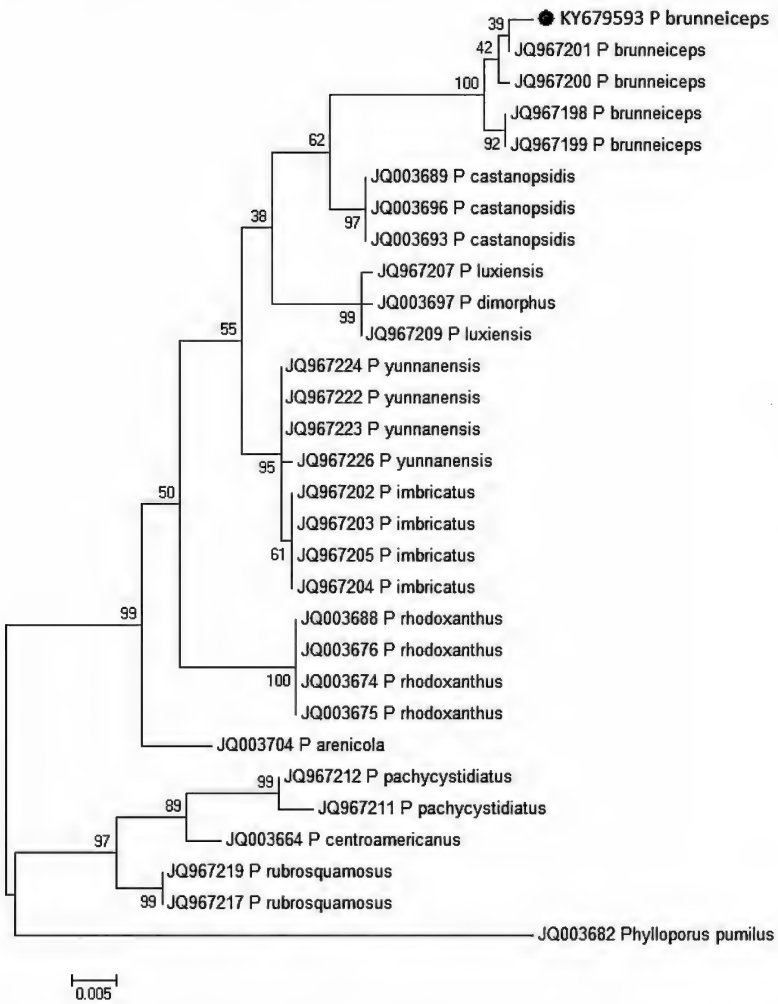

Fig. 3. Molecular phylogenetic analysis of *Phylloporus* based on LSU sequences inferred by the Maximum Likelihood method. The percentage of trees in which the associated taxa clustered together is shown next to the branches. Initial tree for the heuristic search was obtained by applying the Neighbor-Joining method to a matrix of pairwise distances estimated by the Maximum Composite Likelihood (MCL) approach. The tree is drawn to scale, with branch lengths measured in the number of substitutions per site. A new sequence generated from Pakistan are marked with ●.There were a total of 782 positions in the final dataset.

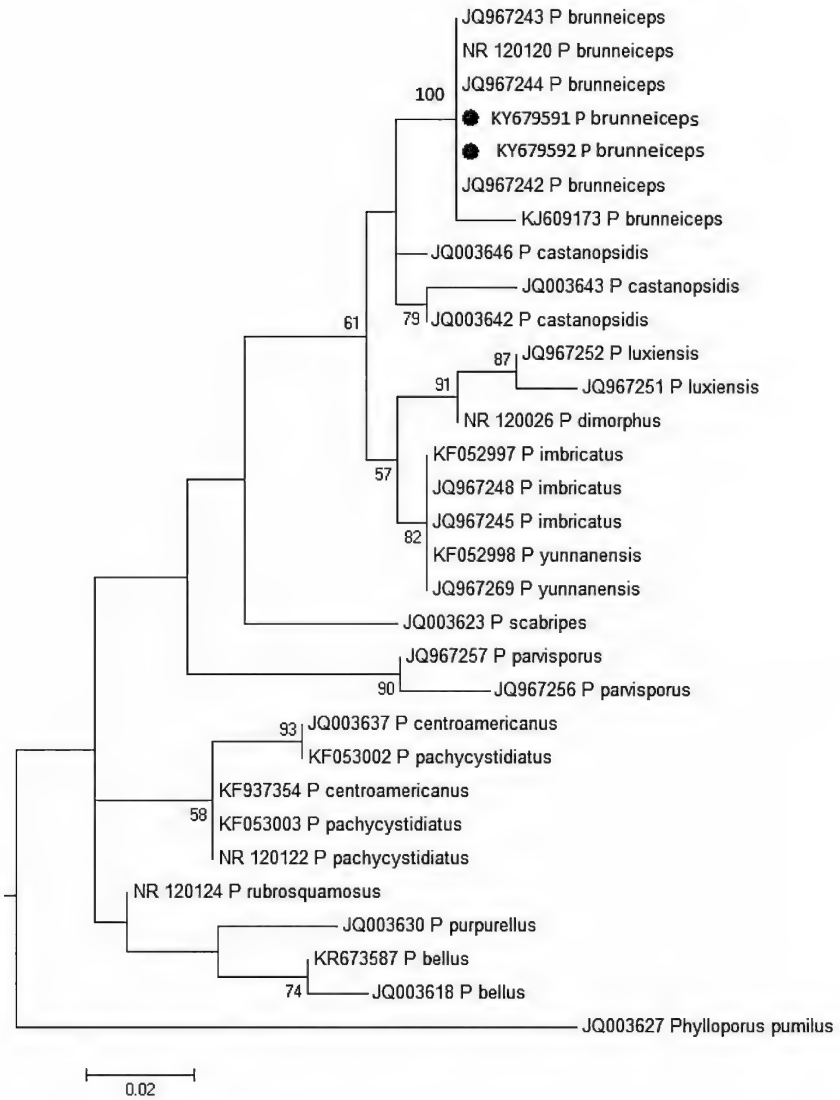

FIG. 4. Molecular phylogenetic analysis of *Phylloporus* based on ITS sequences inferred by the Maximum Likelihood method. The percentage of trees in which the associated taxa clustered together is shown next to the branches. Initial tree for the heuristic search was obtained by applying the Neighbor-Joining method to a matrix of pairwise distances estimated by the Maximum Composite Likelihood (MCL) approach. The tree is drawn to scale, with branch lengths measured in the number of substitutions per site. New sequences generated from Pakistan are marked with ● There were a total of 184 positions in the final dataset.

Discussion

Phylloporus brunneiceps is a gilled bolete that is easily recognized in field due to its lamellate hymenophore. It is distinguished by bright yellow decurrent lamellae that change colour when bruised or injured, a brown to dark brown tomentose pileus, and central stipe. Our phylogenetic analysis clustered the ITS and LSU sequences from the Pakistan specimen with the *P. brunneiceps* sequences reported by Zeng et al. (2013). In phylogenetic analysis, *P. brunneiceps* forms a clade with *P. castanopsidis* M.A. Neves & Halling, which is distinguished morphologically by its pale, convex to plano-depressed, dry pileus (Neves et al. 2012).

The Chinese and Pakistani collections of *Phylloporus brunneiceps* differ somewhat morphologically from the Chinese collection, described with a smaller (4–5 cm diam.) pileus and shorter, more slender stipe (3–4 × 0.4–0.7 cm; Zeng et al. 2013).

Previously, *P. brunneiceps* was misidentified in China as *P. rhodoxanthus* (Zang et al. 1996), which differs by its non-staining lamellae and cinnamon brown pileus (Neves & Halling 2010).

Phylloporus brunneiceps has been reported from mixed *Lithocarpus-Pinus* forests in China, while in our study the species has been observed under canopy of *Quercus oblongata* in pure oak forests.

This is the first report of *P. brunneiceps* from Pakistan and so represents an addition to the mycobiota of Pakistan. The species has great potential for mycorrhization in afforestation and reforestation of *Quercus* species.

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Zelotetraploa aquatica gen. & sp. nov. and *Blastoheterospora catenata* gen. & sp. nov., on submerged wood from Brazil

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Abstract—Two new genera and species, *Zelotetraploa aquatica* and *Blastoheterospora catenata*, are described and illustrated. *Zelotetraploa aquatica* is distinguished by monoblastic, globose conidiogenous cells and rectangular to oblong, euseptate, dictyoseptate conidia composed of four rows of cells that develop independently. *Blastoheterospora catenata,* which arises conspicuously from the conidial cell rows of *Z. aquatica*, is characterized by branched blastocatenate conidia that are polymorphic (unicellular, phragmoseptate, dictyoseptate, or subchiroid) and variegated, with a *Conioscyphopsis*-like synanamorph arising rarely from dictyoseptate conidia.

Key words—freshwater, asexual fungi, hyphomycetes, taxonomy

Introduction

The diversity of conidial fungi in the Brazilian semiarid region has received little attention. Taking into account its very variable physical conditions, this region is considered a stressed reservoir of biodiversity. However, its mycobiota, especially saprobic dematiaceous hyphomycetes, is very diverse as has been recently revealed by the discovery of numerous new genera and species (Almeida et al. 2015, Cantillo-Pérez et al. 2015, Fiuza et al. 2014, Gusmão et

al. 2008, Leão-Ferreira et al. 2008, 2013, Santa Izabel et al. 2015, Silva et al. 2015). During a mycological study of fungi associated with immersed vegetal materials in this region, two interesting fungi were collected from submerged wood in a river. These showed remarkable differences from all previously described genera of hyphomycetes (Seifert et al. 2011). Each fungus is therefore described here as a new genus and species.

Material & methods

Samples of plant material submerged in a river were placed in plastic bags for transport to the laboratory where they were gently washed, placed in Petri dish moist chambers, and incubated in a 170 L polystyrene box with 200 mL sterile water plus 2 mL glycerol, at 25°C for 30 days (Castañeda-Ruiz et al. 2016). Mounts were prepared in PVL (polyvinyl alcohol and lactic acid). Measurements were made at a magnification of ×1000. Micrographs were obtained with an Olympus BX51 microscope equipped with bright field and Nomarski interference optics. The type specimens are deposited in the Herbarium of Universidade Estadual de Feira de Santana, Bahia, Brazil (HUEFS).

Taxonomy

Zelotetraploa J.S. Monteiro, Gusmão & R.F. Castañeda, **gen. nov.**

MycoBank MB 822122

Differs from *Tetraploa* by its hyaline or subhyaline hyphae and its globose to ellipsoidal, brown conidiogenous cells.

Type species: *Zelotetraploa aquatica* J.S. Monteiro et al.

Etymology: Greek, *zelo-*, meaning emulation, + Latin, *-tetraploa*, referring to the genus *Tetraploa.*

Colonies on the natural substrate effuse, brown. Conidiophores micronematous mostly reduced to conidiogenous cell. Conidiogenous cells monoblastic, intercalary, determinate, ellipsoidal, globose, brown. Conidial secession schizolytic. Conidia solitary, rectangular to oblong, euseptate, composed of four parallel, tightly packed rows of cells, brown to dark brown, smooth.

Zelotetraploa aquatica J.S. Monteiro, Gusmão & R.F. Castañeda, **sp. nov.** Figs 1–4

MycoBank MB 822123

Differs from *Paratetraploa exappendiculata* by its hyaline or subhyaline hyphae, globose to ellipsoidal conidiogenous cells, and its smooth conidia.

Type: Brazil, Bahia: Piatã, Rio Patricio, 13°09′S 41°46′W, on submerged decaying wood in a river, 10 January 2016, coll: M.C.O. Amorim (**Holotype**, HUEFS 216680).

Etymology: Latin, *aquatica,* referring to the aquatic environment where the species grows.

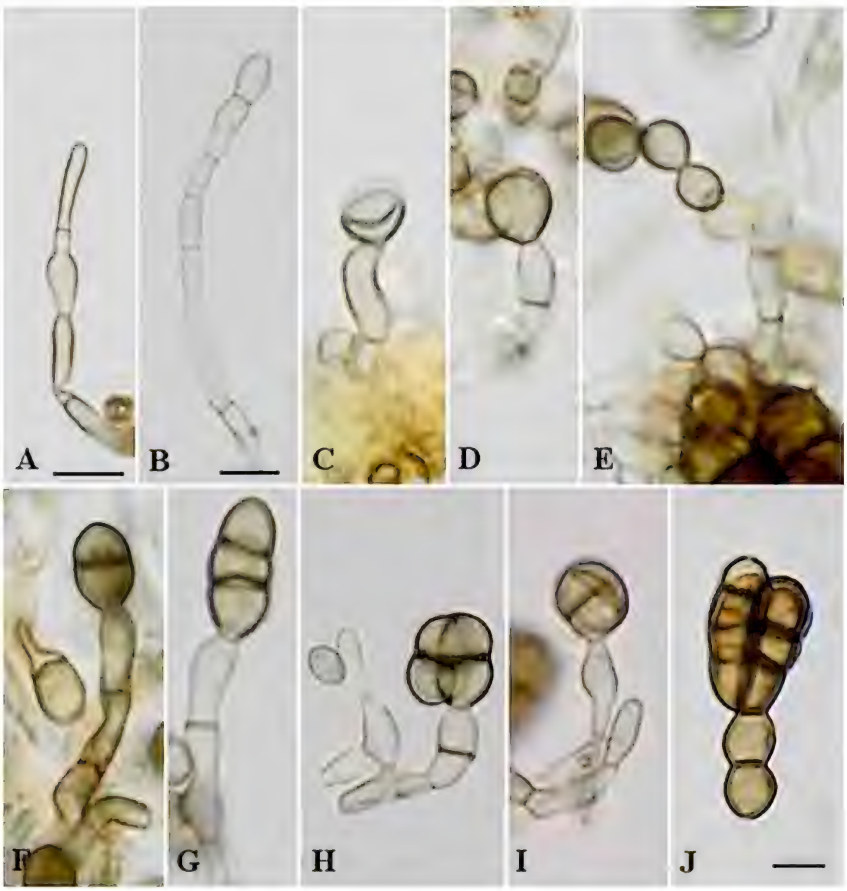

Fig. 1. ***Blastoheterospora catenata*** (holotype, HUEFS 216679): A, B. Conidiophores and conidiogenous cells. C. Conidiogenous cell and collapsed conidium. D–I. Conidiogenous cells and conidia. ***Zelotetraploa aquatica*** (holotype, HUEFS 216680): J. Conidiophore, conidiogenous cell, and conidium. Scale bars: A–I = 10 μm; J = 5 μm.

Colonies on the natural substrate effuse, granulose to farinose brown. Mycelium superficial and immersed. Hyphae septate, branched, smooth, hyaline, or subhyaline, 2–3 μm diam. Conidiophores micronematous, mononematous, globose, sometimes short moniliform, mostly reduced to conidiogenous cells. Conidiogenous cells globose or subglobose, sometimes ellipsoidal, monoblastic, determinate, smooth, brown, 4–6 μm wide. Conidial secession schizolytic. Conidia solitary, rectangular to oblong, euseptate, 14–24 cells, 13–23 × 8–10 μm, composed 4 parallel, tightly packed rows of cells

that develop independently, rows 10–23 × 4–5 µm, 2–6-septate, brown to dark brown, smooth.

Blastoheterospora J.S. Monteiro, Gusmão & R.F. Castañeda, **gen. nov.**

MycoBank MB 822124

Differs from all blastocatenate hyphomycetes by its polymorphic and variegated conidia.

Type species: *Blastoheterospora catenata* J.S. Monteiro et al.

Etymology: Latin, *blasto-*, referring to the conidial ontogeny mode, + Greek, *-hetero-*, meaning different, + Greek, *-spora*, referring to the conidia.

Colonies on the natural substrate effuse. Conidiophores micronematous or macronematous, mononematous, septate, hyaline or pale pigmented, randomly arising from cells of the conidial rows of *Zelotetraploa aquatica*. Conidiogenous cells monoblastic, terminal, determinate hyaline or pale or pigmented. Conidia blastocatenate, polymorphic (spherical, globose, clavate, pyriform, ellipsoidal, obovoid, oblong, cruciate, turbinate, flower-shaped, subchiroid to palmate) unicellular or phragmo- or dictyoseptate, euseptate, hyaline or pale pigmented. Synanamorph *Conioscyphopsis*-like, formed rarely from the tetracellular or dictyoseptate conidia.

Blastoheterospora catenata J.S. Monteiro, Gusmão & R.F. Castañeda, **sp. nov.**

Figs 1–4

MycoBank MB 822125

Differs from all described blastocatenate hyphomycetes by its polymorphic and variegated, unicellular, phragmoseptate, dictyoseptate, or subchiroid, blastocatenate conidia from monoblastic conidiogenous cells on secondary conidiophores that originate randomly from the conidial rows of cells of *Zelotetraploa aquatica*.

Type: Brazil, Bahia: Piatã, Rio Patricio, 13°09′S 41°46′W, on submerged decaying wood in a river, 10 January 2016, coll. M.C.O. Amorim (**Holotype**, HUEFS 216679).

Etymology: Latin, *catenata*, referring to the branched conidial chains.

Colonies on the natural substrate effuse, hyaline to subhyaline or gray. Conidiophores micronematous or macronematous, mononematous, septate, unbranched or slightly branched, 0–7-septate, with cells evidently attenuated at the septa, 5–70 × 1.5–2.5 µm, hyaline, subhyaline, gray to pale brown, smooth, randomly arising from cells of rows of *Zelotetraploa aquatica*. Conidiogenous cells monoblastic, sometimes polyblastic, terminal, integrated, determinate, sub-cylindrical, ellipsoidal, globose, subspathulate, clavate, lecythiform, 3.5–6 × 1.5–2.5 µm, hyaline, subhyaline pale brown to brown, smooth. Conidial secession schizolytic. Conidia blastocatenate, smooth; some are unicellular, hyaline, subhyaline or

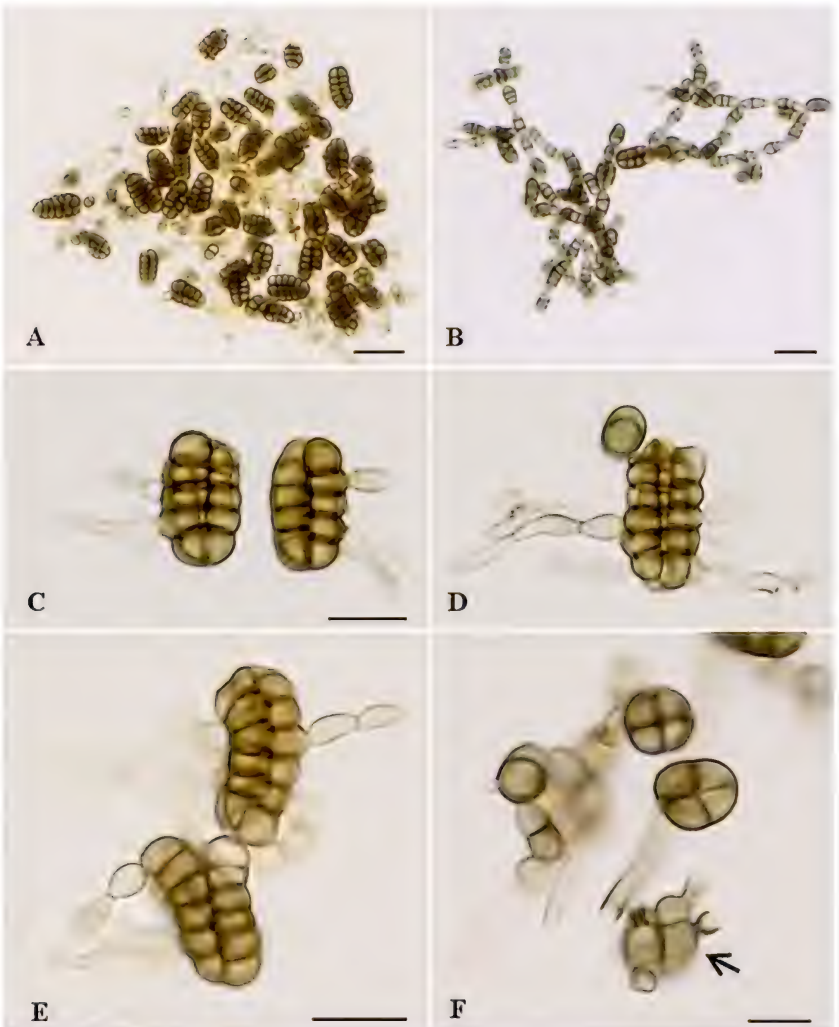

Fig. 2. ***Zelotetraploa aquatica*** (holotype, HUEFS 216680): A, B. Mixed colonies of *Z. aquatica* and *Blastoheterospora catenata*; C–E. Conidiophores and conidiogenous cells of *B. catenata* arising from conidia of *Z. aquatica*. ***Blastoheterospora catenata*** (holotype, HUEFS 216679): F. Conidia and conidiogenous cells of *Conioscyphopsis*-like synanamorph (arrow). Scale bars: A, B= 20 μm; C–F = 10 μm.

gray, spherical 3–4 μm diam. or subglobose 3–4 × 3–3.5 μm; others are phragmoconidia, dirty gray or pale brownish-gray at the apical cell and gray toward the base or concolor dirty gray, always brown at septa,

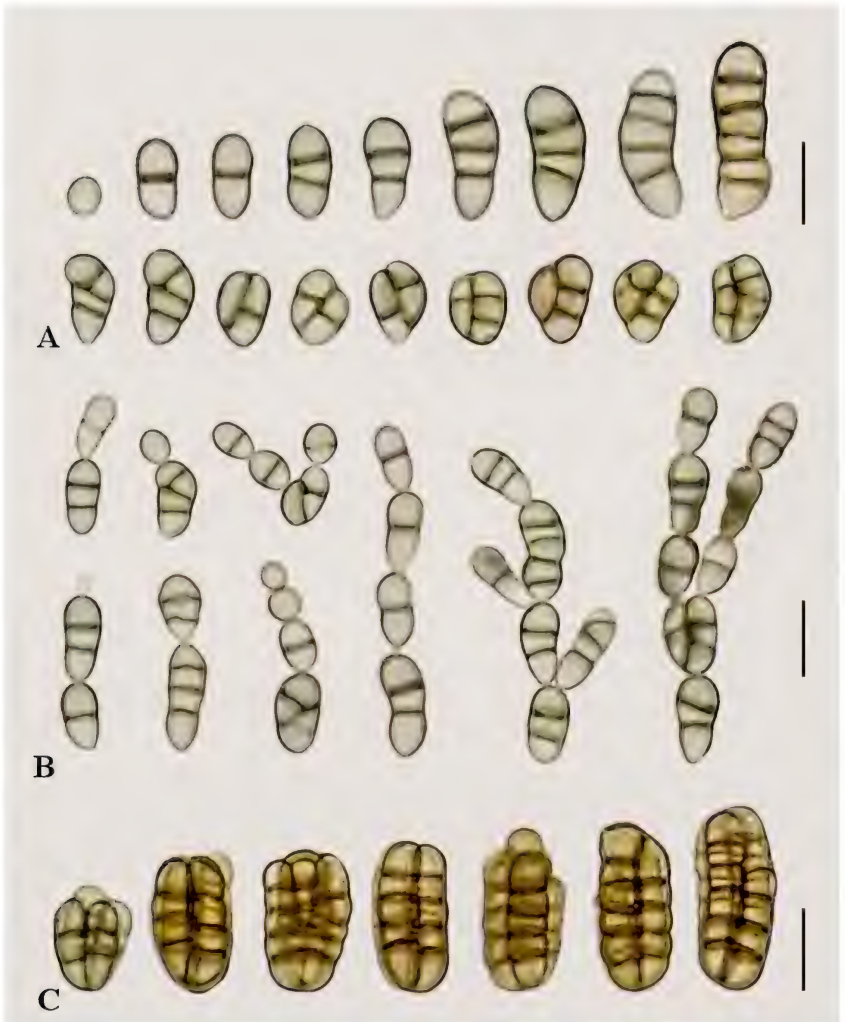

Fig.3. ***Blastoheterospora catenata*** (holotype, HUEFS 216679): A, B. Conidia. ***Zelotetraploa aquatica*** (holotype, HUEFS 216680): C. Conidia. Scale bars: 10 μm.

1–5-euseptate, clavate, pyriform, ellipsoidal, obovoid, oblong, straight or slightly curved, 5.5–16 × 3–4 μm; and others are euseptate, tri- or tetracellular dictyoseptate, cruciate, turbinate, flower-shaped, subchiroid to palmate, very pale brown, brownish-dirty gray, brown or dark gray-brown, darker at the septa, 5–14(–17) × 5–8 μm. Synanamorph *Conioscyphopsis-*

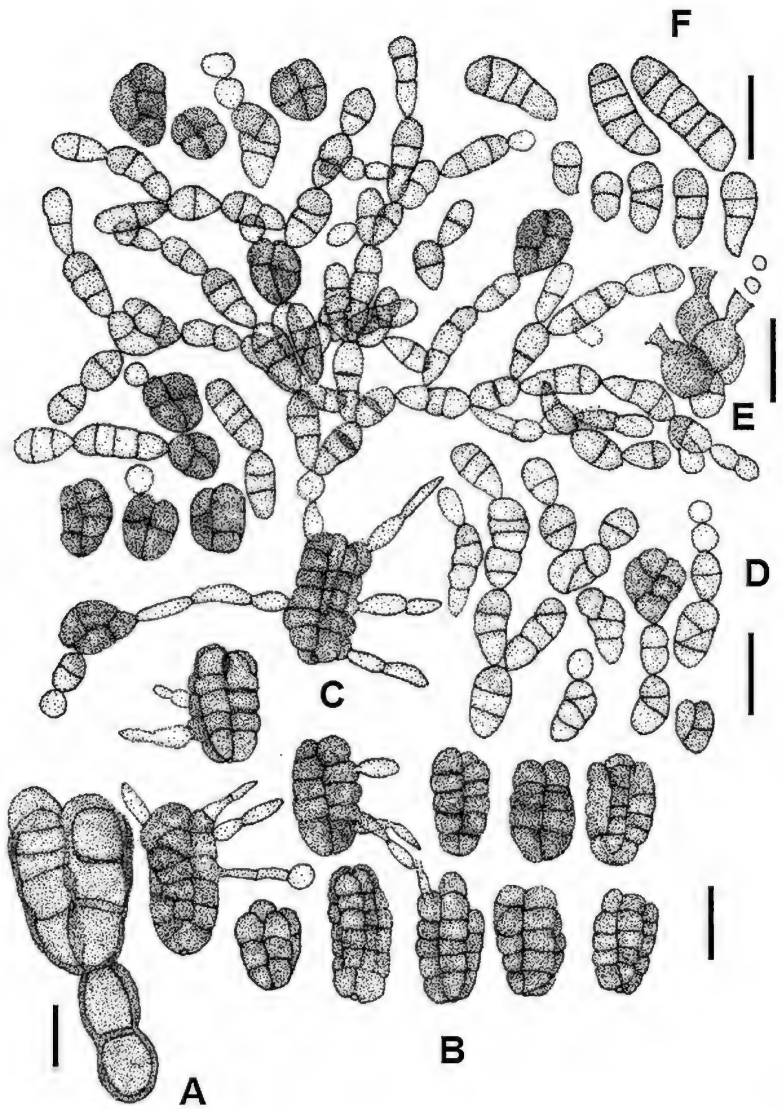

Fig.4. ***Zelotetraploa aquatica*** (holotype, HUEFS 216680): A. Conidiophore, conidiogenous cell, and conidium; B. Conidia without and with conidiophores and conidiogenous cells of *B. catenata*; C. Conidium with extending conidiophores, conidiogenous cells, and conidia of *B. catenata*. ***Blastoheterospora catenata*** (holotype, HUEFS 216679): D, F. Conidia; E. Conidiogenous cells and conidia of *Conioscyphopsis*-like synanamorph. Scale bars: A = 5 μm; B–F = 10 μm.

like conidiogenous cells monophialidic, lageniform to globose, 6–8 × 4–5 µm, with an evident infundibuliform collarette, 2.5–3.5 µm deep, globose, unicellular, pale brown or gray-brown, smooth conidia, 1.5–3 µm diam., poorly sporulated, formed rarely, from the cruciate, flower-shaped, tri- or tetracellular, dictyoseptate conidia.

Comments—The genera *Tetraploa* Berk. & Broome and *Pseudotetraploa* Kaz. Tanaka & K. Hiray. are somewhat similar to *Zelotetraploa*, but *Tetraploa* (typified by *T. aristata* Berk. & Broome) is distinguished by intercalary, cylindrical conidiogenous cells not differentiated from the assimilative hyphae, that produce muriform, euseptate conidia composed of (3–)4 rows of cells with a divergent, 2–3-septate apical appendage (Tanaka et al. 2009). The conidia of *Pseudotetraploa* (typified by *P. curviappendiculata* (Sat. Hatak. et al.) Kaz. Tanaka & K. Hiray. are muriform, distoseptate, and composed of 4–8 rows of cells with setose appendages at the apical part (Tanaka et al. 2009). *Paratetraploa* M.K.M. Wong & K.D. Hyde (typified by *P. exappendiculata* M.K.M. Wong et al.) is similar to *Zelotetraploa* in conidial morphology, but has cylindrical conidiogenous cells not differentiated from the assimilative hyphae that are punctate and smooth and lack synanamorph (Wong et al. 2002, Silva & Gusmão 2017). The presence of twelve conidial forms (determined by varied pigmentation and number of septa) in *Blastoheterospora catenata* is unique among hyphomycetes (Seifert et al. 2011). So far, this peculiarity does not allow comparing it with any other genus described that produce conidia in branched acropetal chains.

We speculate that *Blastoheterospora catenata* might be parasitic on *Zelotetraploa aquatica;* the relationship between these two species requires investigation.

Acknowledgments

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Regional annotated mycobiotas new to the Mycotaxon website

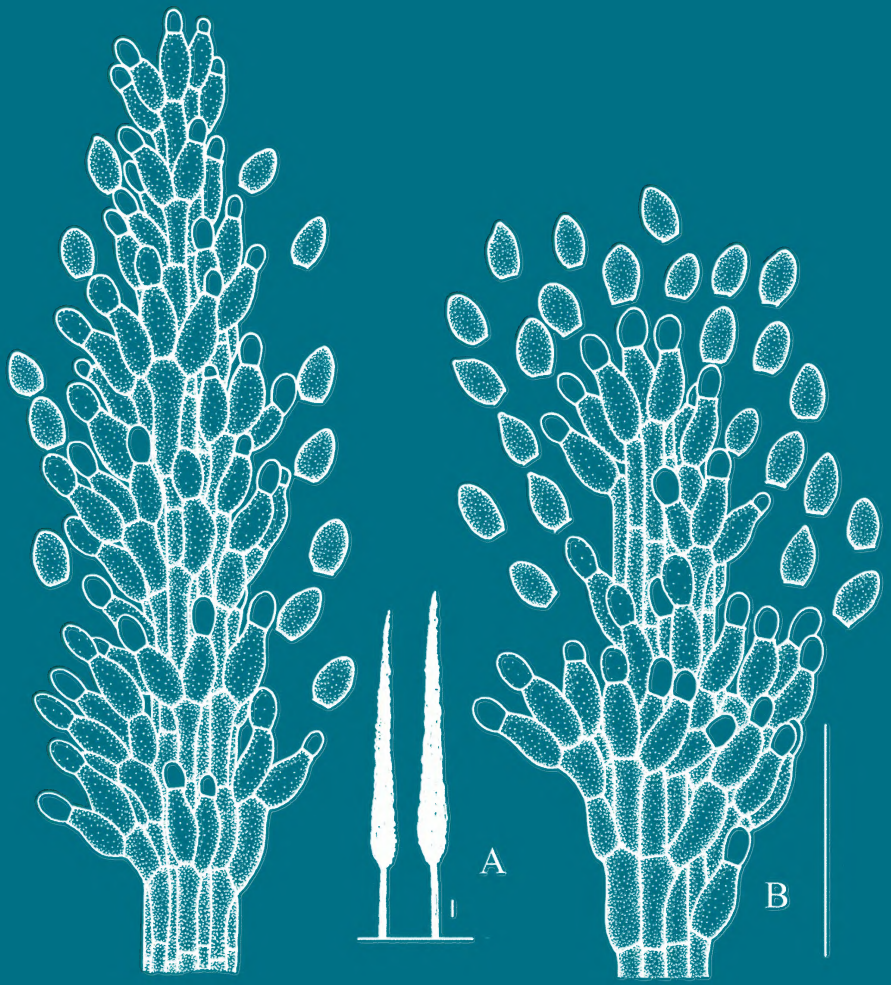
Abstract—Mycotaxon is pleased to announce the posting of a new species distribution list to our web-list page covering the fungi of Homilsha Forests National Park in Ukraine (by Prylutskyi, Akulov, Leontyev, Ordynets, Yatsiuk, Usichenko & Savchenko). This brings to 125 the number of free access mycobiotas now available on the Mycotaxon website: http://www.mycotaxon.com/resources/weblists.html

EURASIA

Ukraine

Oleh V. Prylutskyi, Olexander Yu. Akulov, Dmitry V. Leontyev, Alexander V. Ordynets, Iryna I. Yatsiuk, Andriy S. Usichenko & Anton O. Savchenko. Fungi and fungus-like organisms of Homilsha Forests National Park, Ukraine. 56 p.

Abstract—The annotated checklist of fungi and fungus-like organisms, recorded in the Homilsha Forests National Park, eastern Ukraine, is given. The list includes 1469 species and infraspecific taxa belonging to 10 phyla of *Fungi, Amoebozoa, Stramenopila, Rhizaria,* and *Discoba.* For species studied by the authors of this checklist, names are accompanied by species abundance status (Rare, Occasional and Common). Names are also annotated by literature references (if available); however, the majority of taxa are reported for the first time. Thirty names from the literature could not be interpreted and these literature records are treated separately from the main list.



Cephalotrichum tuffiforme sp. nov.
(Jiang, Wu & al.— Fig. 1, p. 605)
Yue-Ming Wu, artist